MAY 14 1913

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXX NO. 19 | SAN FRANCISCO, MAY 10, 1913 | PER COPY, 25 CENTS

LIBRARY OF CONGRESS MAY 15 1913 PERIODICAL DIVISION

FAULTS IN UNDERGROUND CABLES.
BY W. A. GAINES.

DIAGRAMS FOR LINE CALCULATION.
BY H. C. STODDARD.

WOODEN AND METAL FLUMES.
BY B. A. ETCHEVERRY.

MANUFACTURE OF OIL GAS—II.
BY E. C. JONES.

MATERIALS ADVERTISED IN THIS ISSUE

Batteries
Edison Storage Battery Supply Co.
Johns-Manville Co.

Boiler Feed Water Treatment
Dearborn Chemical Co.

Conduiets
Crouse-Hinds Co.

Controllers
General Electric Co.

Electrical Instruments
Weston Electrical Instrument Co.

Fans
General Electric Co.

Governors
Pierson, Roeding & Co.

Heating Appliances
Simplex Electric Heating Co.
General Electric Co.

Insulators
Hemingray Glass Co.
"Locke," Pierson, Roeding & Co.
Pittsburg High Voltage Ins. Co.

Motors
Century Electric Co.
Crocker-Wheeler Co.
General Electric Co.
Wagner Electric Co.

Piping
Pittsburg Piping & Equipment Co.

Reflectors, "Velurin"
Holophane Works of the G. E. Co.

Sockets, "Shuriok"
Pass & Seymour

Substations—Portable
Westinghouse Elec. & Mfg. Co.

Surface Switches
Cutler-Hammer Co.

Staples
Blake Signal Mfg. Co.

Tool Kits
M. Klein & Sons

Transportation
Southern Pacific Co.

Turbines
Pelton Water Wheel Co.

Wire (Trolley)
"Phono," Pierson, Roeding & Co.

Wire and Cable
Indiana Rubber Co.
New York Insulated Wire Co.
Okonite Co.
Pacific States Electric Co.
Sprague Rubber Co.
Standard Underground Cable Co.

Alphabetical Index to Advertisers, Page 8. **Where to Buy It in the West, Pages, 9, 10.**

Whether in

FEET or POUNDS

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

makes no difference in ordering

"O. K." WEATHERPROOF

wire. You can absolutely rely and have the satisfaction of knowing, whichever way you order, you will not be "shy." Because of

UNIFORMITY, COMPACTNESS and RIGID CONFORMITY

to weight schedules in its manufacture, necessity for ordering any great percentage in excess of actual quantity required is eliminated.

Manufactured in triple braid exclusively, because years of experience in manufacturing insulated wire have demonstrated its superiority as a satisfaction giver.

The first and second braids are thoroughly saturated with dense pitch compound, and applied at high temperature, while the third absorbs any excess compound on the previous layers, and is coated with natural Austrian paraffin wax, ground into the meshes and a permanent highly polished surface given, which sheds rain and moisture.

We are particular! Are you?

Let us show you a few more of the vantage points of "O.K." Weatherproof Wire

PACIFIC STATES ELECTRIC CO.

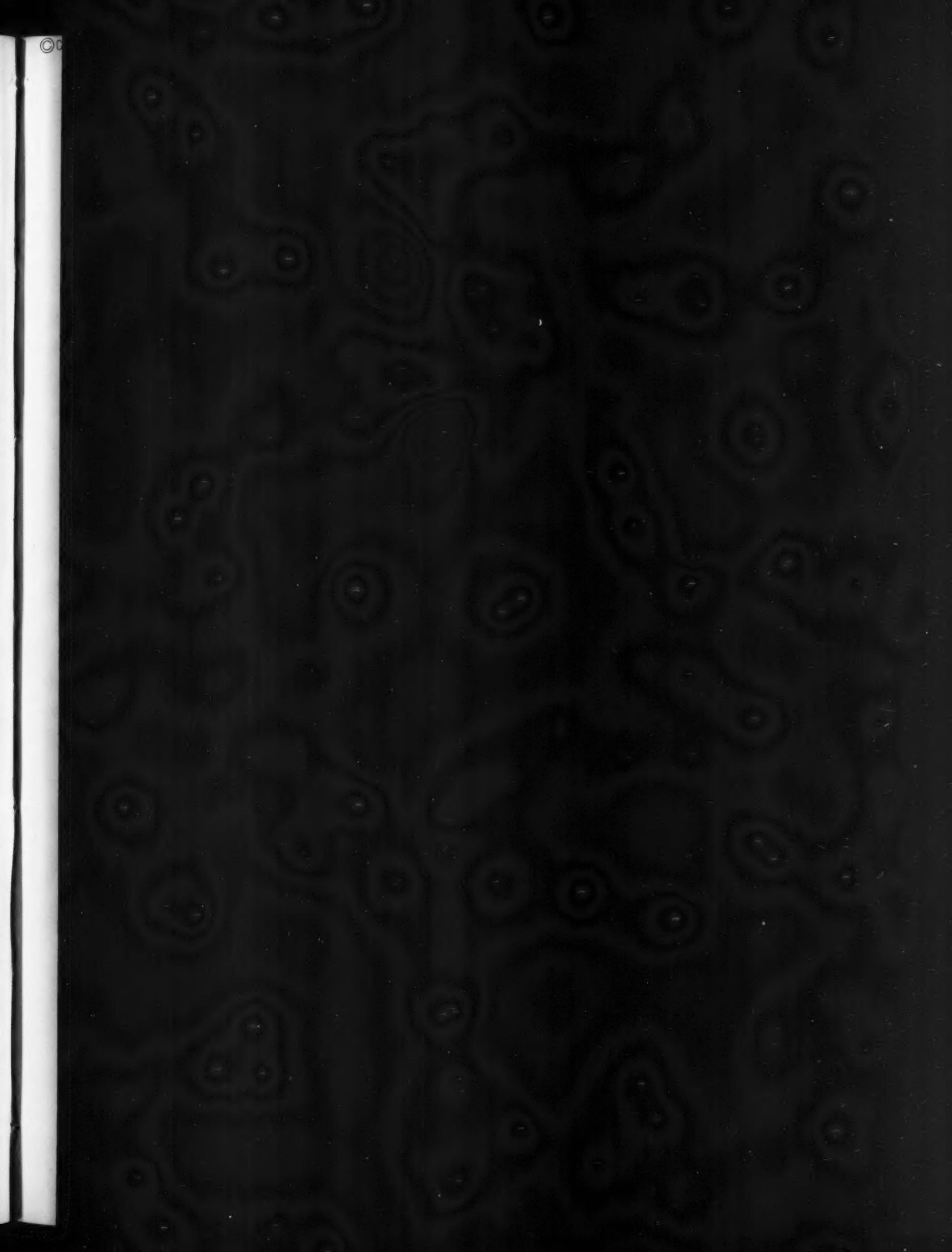
The Modern Electrical Supply House

Distributors for the Pacific Coast

SAN FRANCISCO OAKLAND LOS ANGELES PORTLAND SEATTLE

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

THE PACIFIC STATES ELECTRIC CO SERVES THE PACIFIC COAST



©

©CLB284513

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, MAY 10, 1913 NUMBER 19

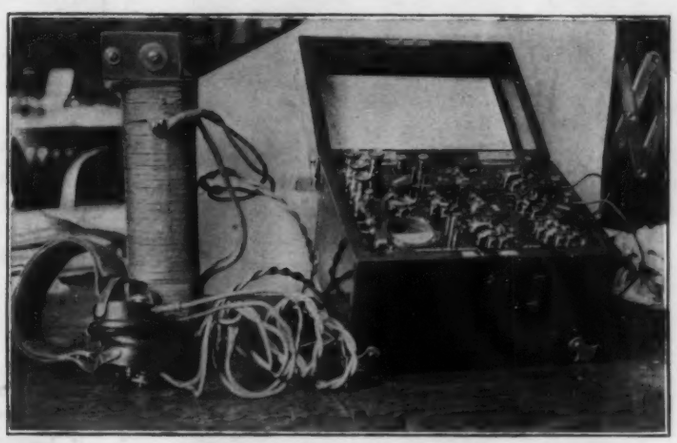
[COPYRIGHT 1913 BY TECHNICAL PUBLISHING COMPANY]

FAULTS IN UNDERGROUND CABLES

BY C. A. GAINES.[1]

In San Francisco most of the electric current supplied to the consumers of the Pacific Gas & Electric Company is transmitted from the generating station located at Humboldt and Georgia streets, to the six substations of the company through sixteen different feeders, which are for the most part underground. About 185,000 ft. of 11,000 volt lead covered cable is used for this purpose, and about 45,000 ft. is used for connecting between the different substations, thus making a total of 230,000 ft. or 43½ miles of 11,000 volt cable.

Burned-Out Splice.



Test Outfit for Finding Faults.

In addition to this there is many times this amount of lower voltage underground cable used for distributing current from the substations, but as these cables have numerous junction boxes where the cable can be easily sectionalized and tested, the finding of a fault becomes a simple matter and only in exceptional cases is it necessary to resort to special methods of testing to determine the fault location.

The following tests are therefore more often used on the power house cables, which are continuous from station to station, and on which the opening of a splice to test is an expensive as well as a slow process.

These power house cables, as they are called, consist of three copper conductors carefully insulated from one another and from the ground and the whole then incased in a sheath of lead ⅛ in. thick, which makes the cable impervious to moisture. Cable failures are often due to an injury of the lead covering, allowing moisture to enter the insulation and thereby reducing its insulating qualities and permitting the current to go to the ground, producing a fault known as a "ground," or to go from conductor to conductor, which is known as a "short."

The resulting fault, which one may be called upon to locate, may consist of a short between two or three of the conductors, or a ground upon one or more, or a combination of shorts and grounds, or sometimes all the conductors may be burned clear from one another and from the ground. In the latter case a test from one station will probably reveal a different condition than a test from the other end of the cable.

As the lead covered cables are installed in underground ducts with but a few feet exposed in manholes, which are located 200 to 500 ft. apart, it can readily be seen that the location of a fault is not simply a question of inspection. Not more than 3 per cent of

[1]Cable testing expert for the Pacific Gas & Electric Company.

the total length of a cable can be seen after it has been installed, yet it is advisable, where time is an important factor, to immediately start an inspection of manholes, for, on a cable a mile long, an inspection of the cable in the manholes, started from both ends, can be completed before a location can be made by testing from one end. Often, too, an odor of burnt insulation will reveal the location of the fault when it is several feet from the manhole in the duct. While this inspection is progressing tests should be made at the station to determine the character of the fault and then preparations should be made for one of the following tests.

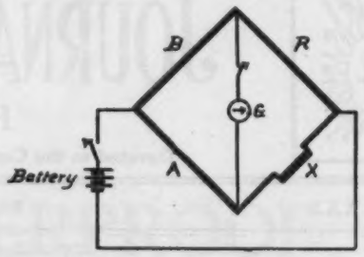
The most easily understood method of determining the location of a fault by test is to send an interrupted current over one conductor through the fault,

High-Tension Cable Junction.

returning in the case of a short through another conductor, and in the case of a ground through the earth. An exploring coil, consisting of an iron core wound with a large number of turns of fine wire, with a telephone receiver attached, is then held near the defective cable and the presence or absence of the pulsating current can be determined by the sound in the receiver.

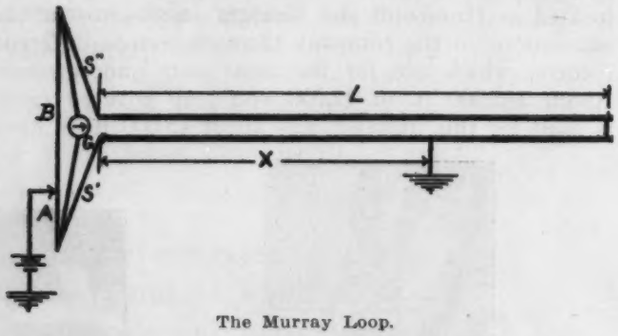
When testing for a short the spiral arrangement of the conductors is taken advantage of and the coil is held with axis parallel to axis of cable, but when locating a ground the coil is held across the cable. The coil should be moved around the cable in order to get the maximum effect from the testing current, as well as to reduce the effect of other current carrying conductors in the neighborhood.

In locating a ground the return current may follow the lead covering of the cable for some distance, neutralizing the effect of the current within the cable,



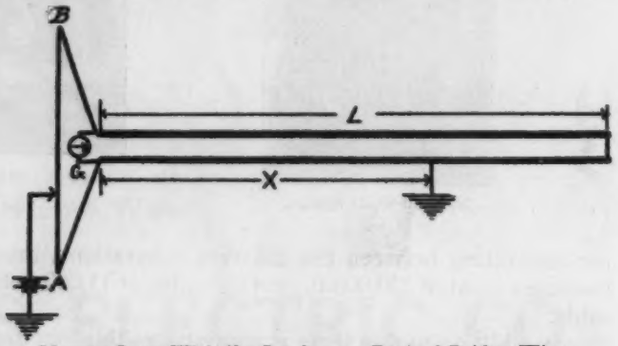
The Wheatstone Bridge.

and, instead of obtaining a definite location the operator finds a zone where the sound given by the exploring coil is very faint. The sound may cease entirely before the fault is reached, or it may continue some distance beyond the fault, making this method of locating a ground at best, but an approximate one.



The Murray Loop.

There are two methods using the principle of the Wheatstone Bridge which depend upon the resistance of the conductor from station to fault. In finding the ratio between this resistance and the resist-



Murray Loop With the Leads as a Part of Bridge Wire.

ance of the entire length of one conductor we have the ratio between the distance to the fault and the length of the cable. For instance, if the resistance of the conductor as far as the fault is one ohm, and the resistance of the conductor from station to station is three ohms, then the fault is 1/3 of the distance from the testing station.

The Murray loop test is the most readily understood of the two, and also has the advantage that it can be used with a slide wire bridge with almost no

calculating. In this test a loop is made with one good conductor and one faulty conductor by connecting them together at the opposite end of the cable from which the test is made. In the case of a grounded conductor the battery is connected between the slide and the ground, the return for the battery being through the fault. A sensitive voltmeter, or galvanometer, is connected to both ends of the slide wire where they join the cable loop. When the fault consists of a short, one faulty wire is used in place of the earth.

Double Slide Wire Bridge.

In either case it is necessary to have one good conductor, although this does not have to be one of the three in the faulty cable. However, if the good conductor is not of the same length, or of the same size, as the faulty one this method of testing becomes more complicated and the Varley loop test, mentioned later, will give more satisfactory results. The Varley loop test also gives more accurate results where the resistance of connecting wires is an appreciable per cent of the resistance of cable under test.

For locating a ground the connections of the Murray loop test are shown in Fig. 1. The slide is moved until there is no deflection of the needle of the instrument "G," then

$$X = \frac{2AL}{A+B}$$

with the bridge in use in San Francisco $A + B = 200$ cms., which reduces this equation to

$$X = A\% \text{ of } L.$$

Suppose $A = 33$ Cms. on this bridge, then $X =$ 33% of the total length of the cable.

(To be continued.)

DIAGRAMS FOR LINE CALCULATION.

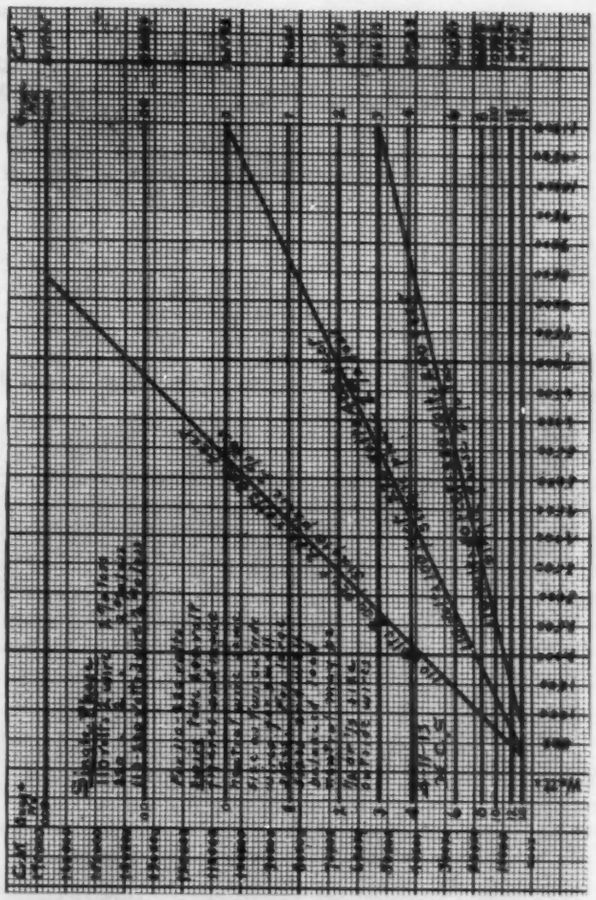
BY H. C. STODDARD.

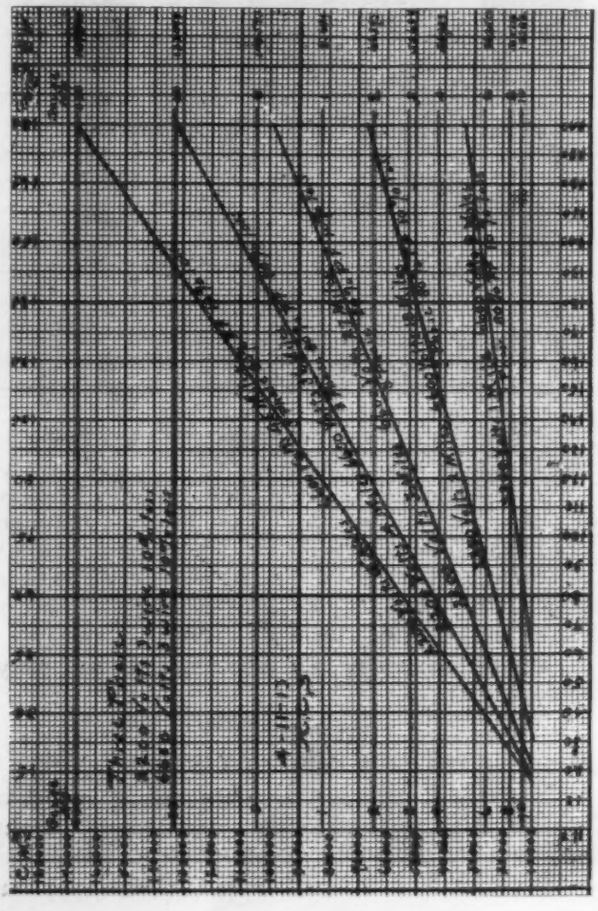
The accompanying charts were recently submitted at a meeting of the California-Oregon Power Company's Club with the idea of furnishing the field men with the method of preliminary calculation of transmission lines. They are based on the general wiring formula:

$$\text{Size wire in circular mils} = \frac{\text{Distance} \times \text{Watts} \times K}{\text{Per cent loss} \times \text{Voltage.}}$$

$$\text{Per cent loss} = \frac{\text{Distance} \times \text{Watts} \times K}{\text{Circular Mils} \times \text{Voltage}^2}$$

Distance = Distance in feet one way.
Watts = Total watts to be delivered
For direct current $K = 2160$.
For single-phase lights only $K = 2400$.
For single-phase lights and motors $K = 3000$.
For single-phase motors only $K = 3380$.
For three-phase motors only $K = 1690$.
For three-phase motors and lights $K = 1500$.
For three-phase lights only $K = 1200$.
For iron wire multiply $K \times 6$.
For three-phase iron wire use $K = 10{,}000$.

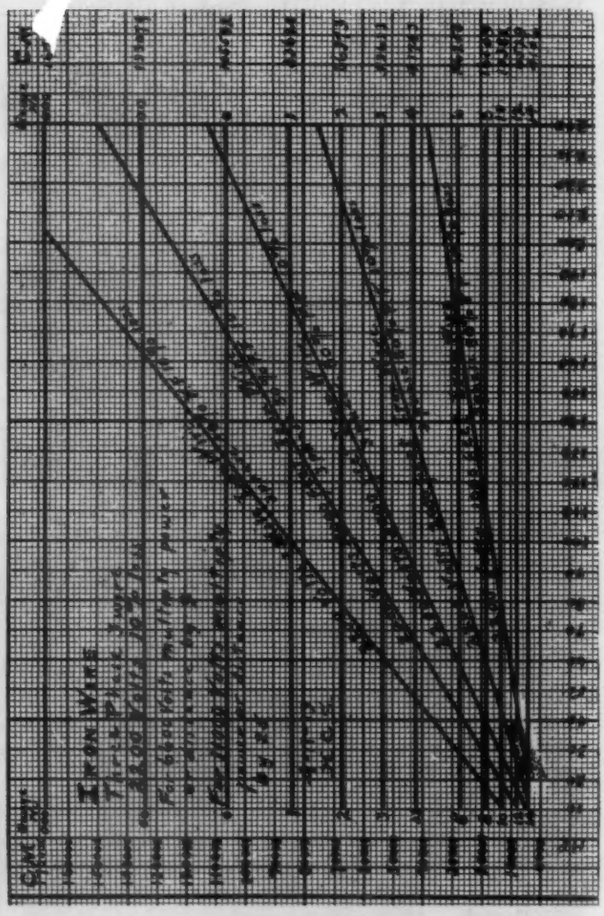


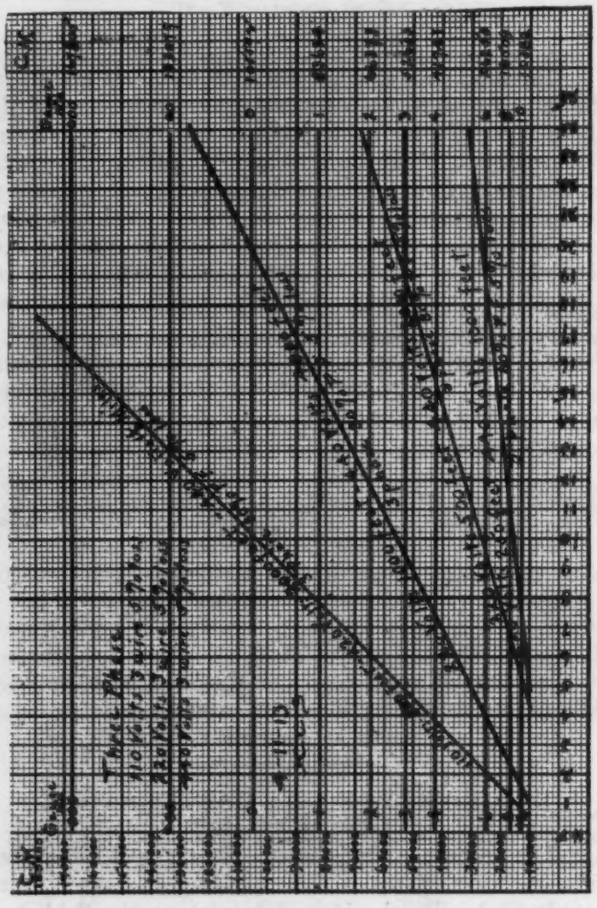


WEIGHT OF WIRE.

Gauge No.	Amperes Carrying Capacity Weatherproof.	Iron. 1000 ft.	Iron. Mile.	Bare Copper. 1000 ft.	Bare Copper. Mile.	Insulated Copper. 1000 ft.	Insulated Copper. Mile.	Steel Core Aluminum. 1000 ft.	Steel Core Aluminum. Mile.	Stranded Aluminum. 1000 ft.	Stranded Aluminum. Mile.	Aluminum Equivalent in Carrying Capacity to Copper Gauge No.
14	16	19	100	13	68							
12	23	32	170	20	106							
10	32	50	260	32	166	53	280			9½	50	12
8	46	72	380	50	264	75	395			15	80	10
6	65	102	540	80	420	112	590			24	126	8
4	92	138	730	128	674	164	865	57	302	39	204	6
2	131			202	1071	260	1370	91	492	61	324	4
1	156			254	1351	316	1670	114	606	77	408	3
0	185			320	1703	470	2150	144	764	97	513	2
00	220	4-11-13		470	2150			182	964	122	648	1
000	262	I. C. S.		510	2710			230	1217	156	817	0
0000	312			6[illegible]	3420			290	1534	196	1030	00

Iron wire six times resistance of copper. Figure one-sixth the power or one-sixth the distance.





The diagrams are self-explanatory, three being for copper wire transmission or distribution and one for iron wire. The vertical lines show watts to be delivered, the oblique lines, the voltage, distance and number of phases, together with the percentage loss, while the horizontal lines show the size of wire. The operations are reversible so that any desired factor may be determined when the others are given.

The accompanying table gives weights and carrying capacities.

TELEPHONE STATISTICS.

Interesting statistics from the annual report of President Vail to the stockholders of the American Telephone and Telegraph Company are as follows:

Fourteen billion, four hundred million telephone conversations in a single year, 1911, is the estimate given by President Vail, based upon the last available figures. For the American Telephone and Telegraph Company and its connected lines, that is, the Bell System, there were approximately 8,172,000,000 telephone conversations in 1912, as against 7,770,000,000 in 1911. In the Bell System there are altogether 7,456,074 telephone stations, an increase over last year of 823,449 stations. That the telephone has indeed become a household necessity in the United States is indicated by these figures, and by the further fact that there are now 70,000 towns, cities and hamlets from which telephone messages may be sent. This is 5000 more than the number of postoffices in the United States; 10,000 more than the number of railroad stations, and nearly three times the number of regular telegraph offices.

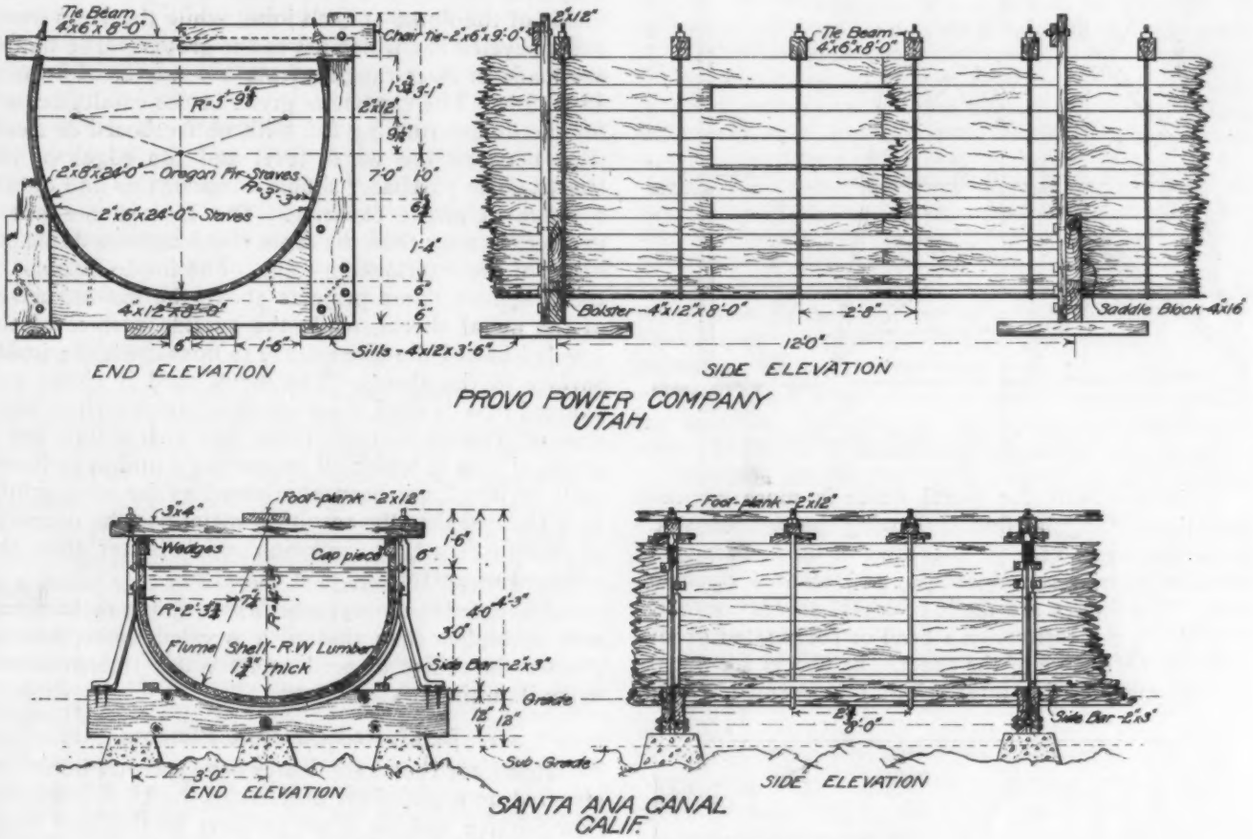
ELECTRICAL PUMPING AND IRRIGATION

WOODEN AND METAL FLUMES.

BY B. A. ETCHEVERRY.

Economic Design of Wooden Flumes.

The most economic flume is the one which will give the lowest total cost of flume lining, framework and substructure. The cost of framework can be decreased by spacing the side posts far apart, but this increases the cost of the lining. The economic relation is obtained by using a thickness of lining which will give the minimum cost for flume lining and framework. The minimum thickness of lining is about 1½ in. The cost of trestle work and foundation is decreased by making the span between bents as large as feasible but this increases the cost of stringers. The economic span is smaller for a low trestle than for a high trestle.



Details of Wooden Stave Flumes, Utah and California.

Semi-circular Wooden Stave Flumes.

This type of flume resembles the stave pipe. The flume box is formed by wooden staves. Two types have been used. In one type the flume is built in sections 8 ft. long. The ends are supported on T irons curved to coincide with the flume. Between the supports the staves are bound by 2⅝ round steel rods fastened by means of nuts to two horizontal tie beams which rest on the top edges of the flume box. At their ends the staves are tightened by means of wedges driven between the tie beams and the edges of the flume, and throughout the middle portion they are tightened by cinching the nuts of the two iron rods. The other type is made continuous, the staves being connected at their ends by metallic tongues and are broken-jointed. Half-inch steel bands pass through tie beams and the flume can be made water tight by screwing up the nuts at the ends of each threaded band. The flume is supported on wooden chairs placed 10 to 12 ft. apart. Each chair consists of a bolster, two vertical pieces curved by band sawing to suit the exterior of the flume, and a straight tie beam.

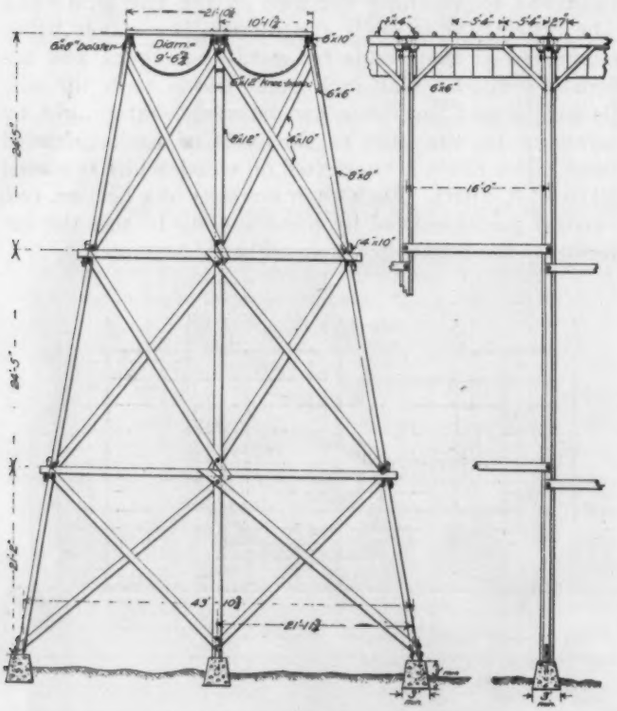
The semi-circular flume has some advantages over the rectangular flume. It is easily adjusted to curves; it can be made water tight by screwing up the nuts at the ends of the rods and it has fewer supports because each 12 ft. length acts as a girder. From experiments on the carrying capacity of semi-circular flumes the coefficient of roughness has been found to be equal to about .012.

Steel Flumes.

The steel or metal flumes used for irrigation are of two types: rectangular and semi-circular.

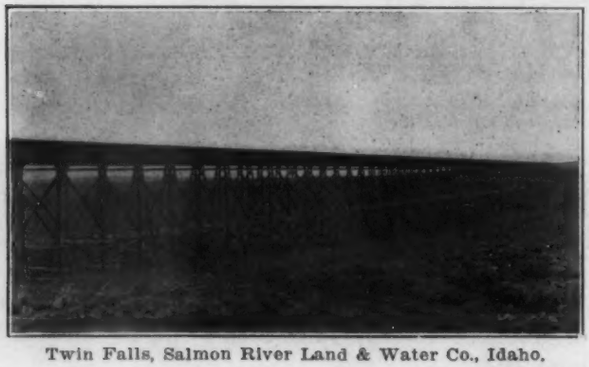
The rectangular form has been used only in a few cases. The waterway or flume box is formed by the two sides, which are plate girders, and the floor. The side girders are designed as for a plate girder bridge.

They consist of a web strengthened with flange angles and web stiffeners. These girders carry the load between spans. The floor is made of a slab connected to the lower flange of the girder. It consists of a plate strengthened with angles or tees. The substructure usually consists of masonry piers or steel trestle bents.



SHEET METAL TWIN FLUME
MEDINA IRRIGATION CO.
TEXAS

The semi-circular metal flume is more common than the rectangular flume. During the last few years it has become a very popular type of flume because of its cheapness, water-tightness, and ease of construction. The flumes are made of metal sheets curved in a semi-circular form with a bead or corrugated groove rolled in each edge of the sheet. The sheets are put together by means of an interlocking joint formed by over-



Twin Falls, Salmon River Land & Water Co., Idaho.

[Galvanized Steel Flume, 1305 ft. Long—40 ft. High in Center. Flume is 10.2 ft. in Diameter, Capacity 200 Second ft. Sills are Anchored to Concrete Footings.]

lapping the edges which fit over each other. The joint is made tight by means of a curved rod which fits on the outside of the corrugated groove and a curved beveled bar or small channel on the inside. The steel rods carry the weight of the flume. The ends are threaded for nuts and pass through the carrier or tie beams which are supported on stringers usually about 16 ft. long. The stringers rest on trestle bents to which they are connected by bolts. By screwing the nuts the outside rod is drawn firmly against the flume and the channel or bar presses on the inside making a water-tight joint.

There are several makes of flume on the market, of which the best known are: (1) the Maginnis galvanized steel flume, sold by the Maginnis Flume Company, Ideal Building, Denver, Colo.; (2) the Hess flume, sold by the Hess Flume Company, First National Bank Building, Denver, Colo.; (3) the Lennon flume made by the Lennon Flume Company of Colorado Springs, Colo. The construction is very similar, differing only in the method of forming the interlocking joint. The Maginnis flume has a small channel which fits on the inside of the flume at each joint, while the Hess flume has a beveled bar which fits in the groove. The flumes are made in sizes ranging from a diameter of 8 in. to 13 ft. 5 in. The capacities given in the catalogues are for the flumes running full with no freeboard or clearance between the water level and the edges of the sheets. The purchaser should consider this and obtain a flume of ample capacity. The Hess flume has a greater capacity than the same size Maginnis flume because of the interlocking joint. The inside channel of the Maginnis flume projects above the inside surface of the metal sheets, while the outside surface of the beveled bar of the Hess flume is flush with the inside surface of the sheets. The metal used is either galvanized iron or steel sheets or some metal such as ingot iron or Toncan metal. These last two metals are a grade of iron in which all impurities found in ordinary steel or iron have been eliminated as far as possible. It is claimed that the resulting metal has the property of resisting rust or corrosion much better than the common or galvanized iron and steel.

As regards economy, the first cost of a metal flume will be higher than that of a wooden flume, but its greater durability as well as its water tightness will make its ultimate cost lower.

Reinforced Concrete Flumes.

Reinforced concrete flumes have recently been constructed on some of the projects of the U. S. Reclamation Service and on other projects in this and other countries. The flume box of a reinforced concrete flume is generally rectangular and is supported on a substructure of piers, posts or arches. A bench flume of reinforced concrete would consist of two retaining walls and a floor. The flume box may be of the following types depending on the method of design.

1. The sides are designed as cantilever walls to resist the water pressure.

2. The sides are tied at the top by means of tie beams made of reinforced concrete or of steel shapes, and vertical reinforcement is placed in the sides to obtain the action of side posts or beams at each tie beam, corresponding to the framing of a wooden flume. The sidewall between the vertical reinforcement is designed as a slab whose span is equal to the distance apart of tie beams.

3. The sides are tied at the top with tie beams placed farther apart than in previous case and are designed as vertical slabs connected at their lower end to the floor and at their upper end to a reinforced concrete beam formed as part of the sides. The span of the beam is the distance apart between the tie beams.

The method of design depends also on the substructure. When the flume is supported on columns or piers the flume box is carried over the span usually by designing the sides as girders and reinforcing the top and bottom accordingly by supporting the flume on reinforced concrete beams. The floor is designed as a floor slab supported at the side walls or on the beams. The first form is illustrated by the Escondido flume, which, however, is much too heavily reinforced. The second form combined with the first is illustrated by the Hamiz flume. When the flume is supported on arches the sides are designed only for the water pressure. The piers will be of the same type as masonry bridge piers with sufficient base to distribute the pressure on the foundation. When the piers are in running water the upstream edge of the pier is formed into a cutwater. The posts are reinforced concrete columns and are supported on a masonry base or pier which extends above the maximum flow line. The arches may be of masonry or reinforced concrete and are designed as bridge arches.

STRIKE OF PACIFIC GAS AND ELECTRIC EMPLOYEES.

All electrical workers, firemen, machinists, boilermakers and gasmakers (except in San Francisco) in the employ of the Pacific Gas and Electric Company went on strike at 8 A. M. May 7. John A. Britton, vice-president and general manager of the company, issued the following statement:

"The Pacific Gas and Electric Company and its predecessors in interest have for over twenty years past been working in harmony with all the labor organizations affiliated with it, and have cheerfully met all demands for increase of wages and decrease of hours of workingmen, and has granted other conditions for their betterment. Agreements with the gas workers, electrical workers and firemen expired by limitation during the present year. No agreement was in force with machinists. In February, 1913, the Light and Power Council of California was organized, embracing boilermakers, stationary firemen, machinists, steam engineers—L. U. 171, gas workers (except San Francisco), and electrical workers, and subsequently on March 6, 1913, presented to the Pacific Gas and Electric Company a joint agreement with above organizations covering all of the territory of the company.

"The Pacific Gas and Electric Company on March 31, 1913, declined to recognize the Council, and so notified it, but on April 7, 1913, reconsidered its determination and agreed to recognize and enter into negotiations with said Council. Subsequently, on April 14, 1913, and continuing thereafter until April 25, 1913, conferences were had with representatives of the Light and Power Council and representatives of the company in discussion of the agreement submitted.

"On Monday, April 28, 1913, a counter proposition was submitted by the company which offered a substantial increase of wage and betterment of working conditions, and an allowance of one day's rest in seven to all monthly employees with full pay, and one day's rest in seven to all other employees as well, and on Tuesday, May 6, 1913, in conference held between the Light and Power Council and the company the proposition of the company as submitted was declined, and the company notified that unless the agreement as submitted by the Light and Power Council was accepted a strike would be called.

"The company then submitted to the Light and Power Council a proposition to leave to arbitration the question involved between the company and the council, which proposition to arbitrate was declined by the Light and Power Council.

"At a conference lasting from 2 o'clock P. M. to 6:15 o'clock P. M. on Tuesday May 6, 1913, it was brought out that the company and the council agreed upon the rate of wage, hours of employment and conditions of work insofar as the gas workers, machinists and boilermakers were concerned, but could not agree upon the rate of wage, hours of employment and conditions of work submitted by the electrical workers and firemen, and thereupon the conference adjourned, the company refusing to accept, as a whole, the agreement submitted, as it could not accede to the demands of the electrical workers and the firemen.

"At 9:30 o'clock P. M. of Tuesday, May 6, 1913, the company was notified by the council that a strike would be called at 8 o'clock A. M. on May 7, 1913, involving the gas workers in all the territory (except San Francisco), all firemen, machinists, boilermakers and electrical workers throughout the entire territory of the company, although the schedules submitted by the gas workers, machinists and boilermakers were satisfactory to both parties.

"The Pacific Gas and Electric Company declined to accept the demands of the Light and Power Council insofar as the schedules of the electrical workers and firemen were concerned, and for the following reasons:

"The rate of wage submitted was a demand in excess of any agreement made by the said bodies with organizations similar to the Pacific Gas and Electric Company in the State of California, and the working conditions were more burdensome and onerous.

"The company considers the demands of the Light and Power Council for the electrical workers, and to an extent the firemen, as arbitrary and unjust, and placing a burden upon the company unequal in character, since no other company in the state is requested to operate under like conditions, and the limitation of the company's ability to pay an advance wage and to bear other financial burdens imposed has been reached, and the extent to which the company could go was expressed in an agreement submitted by it in a compromise proposition.

"The company deprecates the privations of consumers that may ensue by reason of the strike declared. It will endeavor to operate its plants insofar as it is possible to do, but may, because of a lack of men, be compelled to shut down some of its plants, and therefore deprive the public of light, heat and power.

"It feels that it is fighting for a principle, and therefore asks the indulgence of the public until this matter is adjusted by the only fair means known, and that is—arbitration.

"The company's attitude in the past toward labor should be sufficient guarantee that it is not declining a reasonable request, but is resisting arbitrary and unjust requirements, not warranted by conditions at present.

"The company is confident that had it been dealing with each organization, separately, it would have had no difficulty in arranging a proper schedule, satisfactory to all parties, with each of the organizations, and that it was prevented from doing so by the arbitrary action of the council in upholding the unusual demands of the minority of the crafts affiliated with the council."

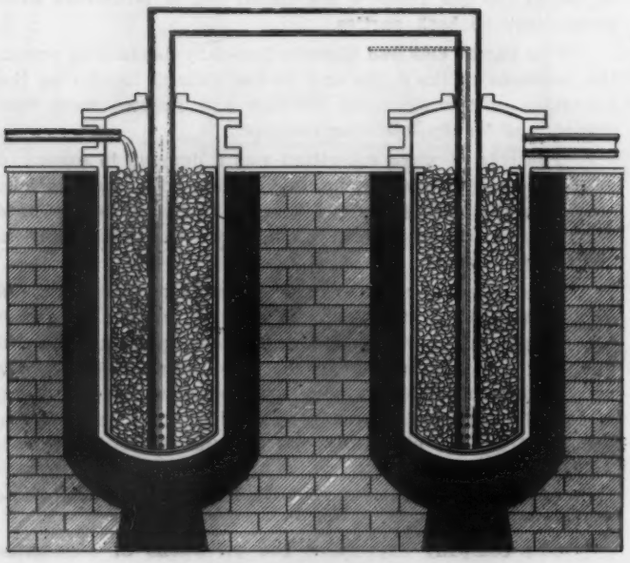
GAS ENGINEERING

THE MANUFACTURE OF OIL GAS.—II.

BY E. C. JONES.

Of all the substances from which gas is made, oil is best suited in every way. It naturally contains every element needed in illuminating gas, and combinations of elements so arranged that it only needs the skilful touch of the chemists to rearrange them into any desired gas without waste. Compared with solid fuel, oil may be more conveniently and cheaply handled, and may be stored in smaller space. The steam or electrically driven pump takes the place of the shovel, wielded by manual labor, as well as every form of mechanically operated coal handling device. The metal oil tank displaces the wooden coal shed, and each cubic foot of oil contains 67 per cent more energy than a cubic foot of coal as stored. A cubic foot of California petroleum contains 1,151,172 British thermal units, while a cubic foot of bituminous coal contains 689,000 British thermal units.

TAYLOR'S OIL GAS APPARATUS
1827



FROM THE "FRANKLIN JOURNAL."
PHILADELPHIA, DEC. 1827

The ready adaptability of oil to gas making caused the pioneers of the industry to divide their attention between oil and coal, and many of the early efforts to design apparatus, show that more ingenuity was used in devising means to distill gas from oil than from coal.

An example of this is the description of Taylor's Patent Gas Apparatus (for making gas from oil) in the Franklin Journal, Philadelphia, 1827. This was nine years (1836) before gas was supplied to the inhabitants of Philadelphia. It is interesting to quote from this old journal to better understand the slowness with which gas-lighting was introduced:

"As experience has demonstrated that gas lights may be advantageously substituted for the former methods of obtaining artificial light in a greater number of cases, and particularly in cities, and in many extensive manufactories, the subject has become one of high interest. New York and Baltimore already enjoy the benefits of this improvement; and we apprehend that Philadelphia will not long lag in the rear, that hyper-prudence, which is thought to be one of her characteristics, to the contrary notwithstanding."

The Taylor method of making oil gas consisted of two vertical iron retorts set in a single furnace. These retorts were furnished with a mouth piece and luted lid at the top end. A metal pipe passed through each lid to near the bottom of the retort, and the lower end of each pipe was perforated with holes. These pipes were connected together at the top so that the retorts were used in tandem. The retorts were filled with broken bricks. This is the first recorded use of checker-brick.

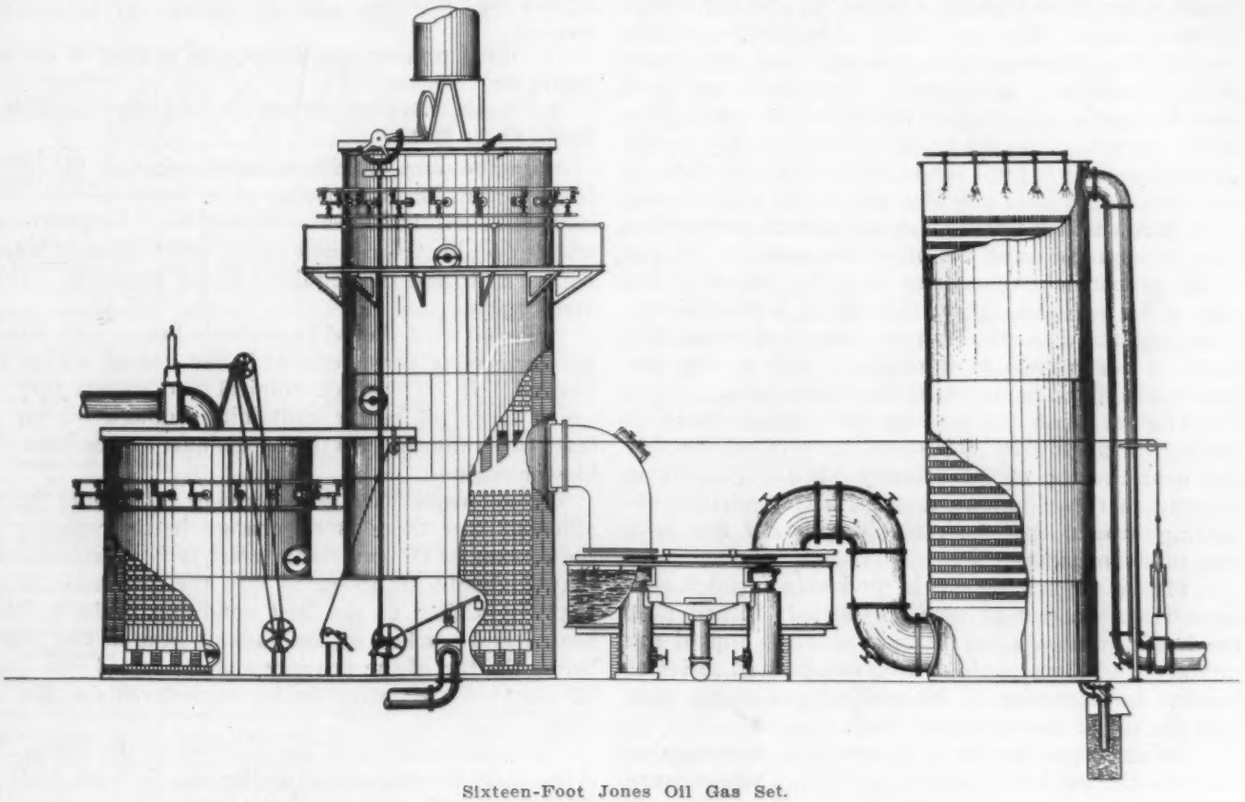
To make gas, the retorts were externally heated until the broken bricks were red hot. Oil was then admitted to the space above the brick in one of the retorts, and passing downward through the broken brick entered the central pipe through the perforations and passing upward and over into the pipe in the second retort, escaped through the perforations in the bottom of the second pipe and finally passed upwards through the broken brick in this retort and through an outlet pipe in the mouth-piece of the second retort. In this way the oil was gasified. The inventor probably never knew how many essentials of modern oil gas making were included in his invention, and could a plentiful supply of petroleum have been substituted for the sperm oil of those days, it would have changed the history of the gas business.

The city of Edinburgh, Scotland, was lighted by oil gas in 1824, when the Edinburgh Oil Gas Company was established with Sir Walter Scott as chairman. The failure of the undertaking plunged this noble and brilliant man into debt from which he never recovered, and the whole of the money received from many of his works was turned over to his creditors. Evidently the time was not ripe for oil gas.

It would require a volume to record the oil gas processes invented and promoted between the failure of the Edinburgh Company and the water gas invention of Prof. Lowe. These depended on external heating of retorts of various shapes for vaporizing or gasifying oil. Horizontal retorts containing nests of pipes were used for making oil gas for enriching coal gas, and a combination of vertical and horizontal retorts known as the "boot leg process" (from its similarity in shape to a boot) was used to manufacture water gas containing less than ten per cent of carbonic oxide. These boot leg retorts were filled with fragments of limestone with the expectation that the resulting calcium oxide would dissociate steam and absorb carbonic acid gas. The gas made in this way was a primitive form of oil gas varying in its composition with the temperature of the retort, and little,

if any, steam was decomposed in passing through the lime.

During the progress of experiments with this process it was demonstrated that the oxygen of steam will not unite with carbon while it is combined with hydrogen in the form of hydro-carbons. Carbon must be in a free state and heated to incandescence before it will dissociate steam and form carbonic acid gas or carbonic oxide. All of these processes relied upon the treatment of oil under comparatively low temperatures for its destructive distillation, and the conduction of heat through the refractory materials of retorts was both wasteful and ineffectual. The use of oil in the internally heated apparatus of Lowe for the enriching of water gas did not contemplate the breaking down of oil into diluent gases and the cracking of hydro-carbons into hydrogen and lampblack. The temperature now maintained in the superheaters of carburetted water gas sets seldom exceed 1400 degrees F., which is about 1200 degrees F. less than the temperature employed in breaking down oil in the early oil gas apparatus.



Sixteen-Foot Jones Oil Gas Set.

The first step in the evolution of the present method of making oil gas was the patent issued to L. P. Lowe, then of Lynn, Mass., on June 18, 1889, for "Apparatus for the Manufacture of Hydro-carbon Gas." This apparatus consisted of "chambers lined with refractory material and each having an open-work filling of refractory material." In other words generators filled with checker brick and internally heated by combustion of oil and air, thus storing heat in the checker brick to be subsequently used for breaking down the oil during the gas making period.

At the time of the invention it is safe to say, that there was no place in the world, in proximity to a market for the gas, where the price of oil was low enough to permit of the economical commercial success of the process. In that year the entire production of oil in California was only 303,220 barrels. The invention was in anticipation of its usefulness by many years for it was not until 1899 that the first crude oil water gas works was built in California, and the first installation for lighting a large city was started in Oakland in 1902. The apparatus employed consisted of two cylindrical shells lined with fire brick and filled with checker brick. The checker brick were heated by oil injected under pressure with steam, and a blast of air for combustion. In radically departing from all methods previously used for making gas from oil, it was thought to be necessary to subject the oil to extremely high heats, but this destroyed a large portion of the oil, and reduced the candle power of the gas.

A large amount of lampblack was also produced, as much as 30 pounds to the 1000 ft. of gas was no uncommon yield. Thus the lampblack, by-product, and the gas made from the oil, were nearly of equal weight. It was supposed that lampblack was a necessary result of making oil gas, and that the lampblack might be used within the generator for dissociating steam and producing blue water-gas.

It was soon discovered that lampblack was deposited by the destruction of hydro-carbon gas, and that the amount of lampblack produced and the amount of free hydrogen in the gas were closely connected. Samples of early oil gas contained as much as 62 per cent of hydrogen, and the carbonic oxide content was 3 per cent, which is evidence that little, if any, of the steam admitted to the generator was decomposed by lampblack.

In the development of a standard oil gas process it became necessary to discard the use of arches over combustion chambers, because they would not stand the intense blow-pipe effect of the oil fire. The area of the checker brick was increased and means were provided for controlling the heat in different parts of the generators.

These improvements reduced the amount of lampblack made, and the percentage of free hydrogen in the gas. The quantity of oil used to make the gas was cut from over 12 gallons to less than 8 gallons per thousand cu. ft.

The apparatus which now seems to be giving the most satisfactory results in making oil gas consists of two cylindrical shells connected at the bottom by a throat piece, thus forming a letter U, one leg of the U being longer than the other. The shorter of the two shells is known as the "primary" and the longer as the "secondary" generator. These shells are lined with fire brick, and are filled with checker brick. The outlet for gas is placed at about midway the height of the secondary shell, and above this outlet there are a series of arches reaching across the shell to support more checker brick. Air is admitted under pressure for combustion of the oil at the center of the top of the primary shell, and also near the bottom at the side of the secondary shell, this last is called the secandary blast. The outlet for the escape of waste products of combustion is through the top of the secondary shell, and is known as the stack valve.

The oil used for heating the checker brick is sprayed through a number of oil burners on the side and near the top of the primary shell. The oil is pumped to these burners through a ring of pipe extending around the shell, and parallel to this is a ring of steam piping.

The oil for making gas is conducted through separate rings of pipe to separate burners placed near the heating burners on the side near the top of the primary, and there is also a ring of pipe and series of burners for spraying oil for making gas, at the side near the top of the secondary shell.

To make gas for the first time it is necessary to heat the checker brick in both shells to a temperature high enough to ignite oil. This is done by building a wood fire in the primary. Air is then admitted to the top of the primary by opening the blast valve, and oil is then forced through the heating burners under pressure and assisted by steam also under pressure.

The oil burns above the checker brick in the primary, and the heat is transmitted downward through the checker brick and upward through the checker brick in the secondary, the products of combustion passing into the atmosphere through the stack valve.

The process is intermittent, and includes a blowing period and gas making period the same as for water gas. No solid fuel is used as oil is burned completely to furnish heat for the checker brick.

Steam is used for injecting oil, for the purpose of protecting the oil vapor against destruction by overheating, and to add its quota of blue water gas to the oil gas. By this process, gas is made entirely from oil and steam and the elements in the oil and steam provide every element and combination of elements in the gas. The largest oil gas units as used in the cities around the bay of San Francisco are known as 16 ft. sets. The primary and secondary shells are each 16 ft. in diameter, and the set has a rated capacity of 150,000 ft. of gas an hour. If the total amount of oil used to make 1000 ft. of gas is 8 gallons, it is divided between heating and making in about the proportion of 1.3 gallons for heating and 6.7 gallons for making.

The sequence of operations during a blow and run, after the set is in condition to make gas, is as follows:

Heating:

1. **Air is blasted into the primary for 3 minutes without any oil.**
2. **Air is blasted and oil injected into the top of the primary for 7 minutes.**

Making:

1. **Oil is injected into the primary and top of the secondary for 7 minutes.**
2. **Steam is injected without oil for 3 minutes. This is known as the purge.)**

For the purpose of keeping the checker brick free from carbon accumulations, after every eleven runs there is a long blow, air is blasted into the generator, without oil for ten minutes, after which oil is admitted with the air and the regular heating period of 7 minutes begins.

The oil used should be preheated to as high a temperature as is consistent with the use of steam for heating. It is most economical and satisfactory to use a large oil heater containing enough oil for at least two runs, and heated by exhaust steam from the blower engines.

The burner used for spraying oil should be so adjusted that there is no change in the velocity of the stream of oil and steam after it is atomized, and the oil should be projected into the generator as oil fog. It is then in the best condition to be quickly heated and cracked by the radiant heat in the chamber at the top of the primary and converted into fixed oil gas by contact with the hot surfaces of the checker brick.

The temperature of the chamber at the top of the primary at the beginning of the run, is from 1800 to 2100 degrees F., and this falls during the gas making period to about 1200 degrees F., it is then restored during the blowing period. The range of temperatures in the checker brick of the secondary generator is from 1200 degrees to 1800 degrees, F. during the gas-making period.

By exercising care in atomizing oil and regulation of the heat of the checker brick, the amount of lampblack has been reduced from 30 pounds to 10 pounds of dry lamp black per 1000 cu. ft. of gas, and the hydrogen content of the gas has been reduced from 62 per cent to about 45 per cent with an almost corresponding increase in marsh gas. This has resulted in a substantial reduction in the amount of oil used to make the gas, and the gas is of greater heating value.

There have been quite recently some revolutionary improvements in oil gas making. It was discovered that if oil is caused to be dissociated in a hydrogen atmosphere instead of in an atmosphere of its own vapor there is practically no breaking down of hydro-carbons into free carbon, (or lampblack) and

free hydrogen. This means that oil gas can be made without producing lampblack, and practical results with an apparatus provided with a gas chamber show a production of about 5 pounds of lampblack per 1000 cu. ft.

In this new apparatus the oil for heating is not burned directly above the checker brick in the primary, but is consumed in a separate heating chamber at the top of the primary, this chamber also contains a few courses of checker brick. In this way it is possible to heat the checker brick in the primary and secondary very evenly and with no over-head incandescent spots.

After a generator is heated by this method, steam is turned into the upper combustion chamber and is superheated in passing through hot checker brick.

ANALYSES OF GASES

KIND OF GAS	ILLUMINANTS C_nH_{2n}	MARSH GAS CH_4	HYDROGEN H_2	CARBONIC OXIDE CO	CARBONIC ACID CO_2	OXYGEN O_2	NITROGEN N_2	SP. GR.	CANDLE POWER	B.T.U.
COAL GAS MANCHESTER 1857	6.46	34.90	45.58	6.64	3.67	0.00	2.75	.435	16.0	683
"BLUE" WATER GAS	0.00	2.20	50.00	39.75	4.60	0.35	3.10	.537	NIL	322
CARBURETTED WATER GAS ANTHRACITE COAL	13.00	16.00	32.00	23.00	4.50	0.50	5.00	.630	24.0	641
EARLY OIL GAS (LOW)	6.20	25.60	62.40	3.00	0.20	0.40	2.20	.303	18.6	624
OIL GAS OAKLAND	5.00	26.30	55.00	7.70	1.80	0.10	4.10	.375	18.4	598
OIL GAS POTRERO	7.01	34.64	39.78	9.21	2.62	0.16	6.58	.482	19.69	680
CARB. WATER GAS LAMPBLACK	16.50	32.80	24.60	13.70	6.20	0.20	6.00	.647	28.5	814
SAN FRANCISCO POTRERO MIXED	9.80	31.00	38.90	11.00	4.40	0.40	4.50	.516	23.0	700
NEW PROCESS METROPOLITAN	6.00	40.40	41.40	5.30	2.00	0.10	4.80	.440	19.60	714
NATURAL GAS PENNSYLVANIA	0.31	92.60	2.18	0.50	0.26	0.34	3.61	.565	NIL	1000
NATURAL GAS STOCKTON, CAL.	0.00	76.10	0.00	0.00	0.20	0.40	23.30	.655	NIL	816
NATURAL GAS SACRAMENTO, CAL.	0.00	80.00	0.00	0.00	0.00	0.00	20.00	.638	NIL	858
PINTSCH GAS	38.10	57.70	3.40	0.50	0.00	0.00	0.00	.699	60.82	1390
OIL PRODUCER GAS	1.60	4.60	4.60	15.40	5.80	0.20	67.80	.942	NIL	150
PRODUCER GAS MOND GAS	0.00	2.00	24.3	13.8	13.9	0.00	46.0	.820	NIL	153
PRODUCER GAS DOWSON GAS	0.31	0.31	18.73	25.07	6.57	0.03	48.98	.837	NIL	161

Ordinary illuminating oil gas taken from the gas holder is forced under pressure into the top of the primary and the oil for gas making is sprayed into this gas atmosphere.

This catalytic gas is simply borrowed for the purpose and due credit is given for it. Its chemical constituents are re-arranged and its volume is increased, but its heating value is not impaired. By this method of protective heating of a generator, it is possible to maintain the temperature of the checker brick with only a variation of 300 degrees F. between the extremes of blow and run. The accompanying table gives the chemical composition of the new oil gas.

After oil gas leaves the generator it passes into the wash box, which is a hydraulic seal to prevent the return of the gas to the generator. The wash box also serves to separate the lampblack from the gas by a thorough system of washing and the lampblack held in suspension in water overflows from the wash box to the lampblack separators.

The wash-box now generally used is an oval steel tank with flat top and bottom, provided with an inlet dip pipe at one end of the top, and an outlet pipe for gas at the other end. There are no partitions or baffle plates used and the space within the box is clear.

Two large overflows on the side of the wash-box carry away the lampblack and water. A self cleaning principle applied to this wash-box consists in constant agitation of the water in the box. This is done by dividing the main water supply into a number of small streams conveyed by pipes to within a few inches of the bottom of the box. The water is thus forced downward to the bottom of the box and rises to the overflows. The lampblack is washed out of the gas by this turbulent water, and is carried out of the box before it has an opportunity to settle.

The average temperature of the water entering the wash-box is 61 degrees F. and the average temperature of the water leaving the wash-box is 129 degrees F. The amount of water used is about 46 gallons per thousand cu. ft. of gas. When it is available, salt water is used in the wash-box, and also in the scrubbers without the slightest injury to the gas, and although the temperature of the water is considerably raised in both the wash-box and scrubbers, there has never been any trouble from salt incrustation.

The average temperature of the gas at the outlet of the wash-box is 142 degrees F.

The water and lampblack flow from the wash-box through open drains to the lampblack separator. It is necessary to thoroughly scrub oil gas, and more water is used for scrubbing it than either coal or water gas on account of the finely divided particles of lampblack held in suspension in the gas, and these must be completely removed before the gas enters the purifiers. A small quantity of oil tar is also removed from the gas by scrubbing. The scrubber best suited to the treatment of oil gas is the cylindrical steel tower filled with wooden trays, as described in the lecture on "Purification of Coal Gas." The gas inlet is at the bottom and water is sprayed on the top of the trays so that the gas and water flow in opposite directions.

It is customary to use three of these scrubbers for each 16 ft. set, and the amount of water used in each scrubber is approximately 15 gallons per thousand cu. ft. of gas, or 45 gallons per thousand cu. ft. for the complete scrubbing of the gas.

In purifying oil gas the method is the same as that used for the purification of coal or water gas. Oxide of iron is the cheapest and most satisfactory material for this purpose, and if the amount of sulphur contained in the oil is less than one per cent, there is no difficulty in removing all the sulphuretted hydrogen and reducing the sulphur compounds contained in the crude gas to 8 grains per hundred cu. ft. of gas.

When oil containing excessive amounts of sulphur are used for making oil gas, it has sometimes been the practice to re-heat the gas, by passing it

through an auxiliary generator containing heated checker brick. This re-heating process converts the sulphur compounds into sulphuretted hydrogen which is removed in the usual way by iron oxide in the purifiers.

There is never any ammonia present in oil gas as it leaves the generator, although ammonia is formed from the oil in the initial stages of the process, and is subsequently destroyed by contact with the highly heated checker brick, and appears in the gas as hydrogen and nitrogen. The only by-products are lampblack and a small quantity of tar. The lampblack is recovered by separation from water in large wooden separators arranged in two sections by partitions running lengthwise through them to permit the alternate cleaning and use of the sections.

These separators are provided with transverse partitions and skimmers, and the water containing lampblack passes under the skimmer and over the partitions. The specific gravity of lampblack and water is so nearly alike that the separation is necessarily slow, but the particles of lampblack gradually settle through the water to the bottom of the tank. It has been demonstrated that to thoroughly separate the lampblack from the water a large area of separator is required and a consequent slow speed of flow of water through it.

The amount of oil tar made is so inconsiderable that it is customary to mix it with the lampblack for use as fuel, or as a binder to assist in briquetting the lampblack.

In some of the larger plants there have recently been installed mechanically operated dewatering and drum filters for separating lampblack. This is an application to a new use of apparatus used in connection with the cyanide process for treating gold ores. The dewatering filter contains a number of leaves covered with cloth and connected by a rotary valve to a vacuum pump and compressor, which alternately places suction and pressure on each leaf in rotation. This machine treats water from the wash-box containing 3 per cent of lampblack, removing the water and thickening the mixture until it contains 10 per cent of lampblack.

The drum filter, which also uses the vacuum and pressure principle, then receives this mixture and further removes the water until the lampblack scraped from the outside of the revolving drum and falling on a belt conveyor contains 50 per cent of water and 50 per cent of lampblack.

Lampblack in this condition is used as boiler fuel, or after slow draining in a pile is used in water gas generators as a substitute for anthracite coal.

The composition of the drained lampblack ready for use as water gas fuel is as follows:

Volatile matter, including moisture ...	34.15%
Fixed carbon	65.80%
Ash	0.05%
	100.0 %

The amount of lampblack required as generator fuel per 1000 cu. ft. of gas is about 40 pounds, which with 6 gallons of California crude oil will produce lampblack water gas of 30 candle-power.

Lampblack used in this way in a water gas generator reduces the capacity of the generator when compared with anthracite coal by about half, and to overcome this drawback rotary driers are used for further removing the moisture, and the heated, dry lampblack is then made into briquettes the size and shape of a fire brick. This material compares favorably with other generator fuels and the capacity of the apparatus is nearly normal. Lampblack after it leaves the drier is also made into smaller briquettes for domestic use, and as a fuel it is deservedly popular on account of its extremely low ash content. When ignited it glows until it is all consumed.

The analysis of one of these briquettes after it had been stored for a year was as follows:

Moisture	8.5%
Volatile matter	10.8%
Fixed carbon	79.9%
Ash	0.8%
	100.0%

Oil gas is so nearly like coal gas in its chemical composition that it would be impossible to detect one from the other in analyzing samples in the laboratory. To demonstrate this, three analyses are given below in parallel.

Number 1 is an analysis of Manchester Coal Gas.

Number 2 is an analysis made at Martin Station, January 17, 1913.

Number 3 oil gas made at Fresno, Cal., February 7, 1913.

	No. 1. Coal Gas.	No. 2. Martin Oil Gas.	No. 3. Fresno Oil Gas.
Illuminants	6.46	6.6	6.2
Marsh gas	34.90	35.0	37.0
Hydrogen	45.58	42.9	45.6
Carbonic oxide	6.64	7.2	5.8
Carbonic acid gas	3.67	2.0	2.2
Oxygen	0.00	0.2	0.4
Nitrogen	2.75	6.1	2.8
	100.00	100.0	100.0
Specific gravity	.435	.450	.414
Candle power	16.	19.9	20.
British thermal units ..	683	680	685

The candle-power of the oil gas is higher than the coal gas, because of the difference in the quality of the illuminants which yield candle-power. The quantity of the illuminants is nearly the same and in fact a little less in the Fresno oil gas.

The manufacture of oil gas is a live subject of interest to everybody who lives in this land of abundant oil. There is much to be learned about oil gas, and the study of the hydro-carbons, and their behavior at different temperatures will doubly reward the investigator. It is suggested that a study of the effects of heat upon Californiaa crude oil be undertaken with the aid of an electric furnace, which will insure uniform constant temperatures.

GENERAL ELECTRIC COMPANY'S ANNUAL REPORT.

President C. A. Coffin has made the following report to the stockholders of the General Electric Company under date of April 21, 1913, for the year ending December 31, 1912:

Profits from sales		$ 8,107,993.55
Income from other sources		5,002,829.89
		$13,110,823.44
Less interest and discount on debenture bonds	$ 532,087.18	
Dividends paid	6,213,173.92	6.745,261.10
Carried to surplus account for the year		$ 6,365,562.34
The value of orders received during the year was		$102,934,788.00
The amount of sales billed for he year was		89,182,185.80

The foregoing statements include for the first time the business formerly conducted by the Fort Wayne Electric Works, the Sprague Electric Company, and the National Electric Lamp Company. The Fort Wayne Electric Works and the Sprague Electric Company were dissolved and their business merged

	Net book value Jan. 1, 1912.	Additions during year.
Real estate and buildings	$11,933,028.24	$2,224,974.64
Machinery	7,605,891.06	3,198,952.25
Patterns	1.00	93,255.31
Furniture and fixtures	1.50	551,787.72
	$19,538,921.80	$6,068,969.92

with that of the General Electric Company during 1911, while corresponding dissolution and merger of the National Electric Lamp Company was effected during 1912.

The competition referred to in last year's report has continued to increase in severity, with the result that the percentage of profit realized from the sales of your apparatus has materially diminished.

The manufacturing facilities of your company have been substantially enlarged in order to provide for the increasing volume of business. The factory floor area is shown as follows:

	Square feet.
1908	7,000,000
1909	7,180,000
1910	8,530,000
1911 (including Fort Wayne, Sprague and Erie)	9,770,000
1912 (including National Lamp Works)	12,160,000

The growth and extent of your company's interests and operations is evidenced by the number of employees in your factories, offices and subsidiary companies, the total number of such employees being in excess of 60,000.

The number of orders received during the year was 466,895, exclusive of the Fort Wayne, Sprague and National Lamp departments. This represents a steady and nearly uniform increase, the number of orders received in 1907 having been 237,006.

The expenditure of $539,956.93 during the year for the purchase of patents, for applications and licenses under patents and for miscellaneous patent expense, has been charged to Profit and Loss, and the patent account remains at $1.

The stocks and bonds owned by your company have a par value of $23,013,764.54 and are carried at a book value of $23,325,070.38 at December 31, 1912. The principal change from last year is the transfer into the various asset accounts of the General Electric Company of its investment in the National Electric Lamp Company.

The book value of current accounts and notes receivable was $26,950,244.90 on December 31, 1912, after making ample provision for possible losses. Of the accounts receivable only $558,224.92 represents the face value of unsettled accounts originating earlier than January 1, 1912. From affiliated, manufacturing and selling companies there was due a total of $4,099,-062.64, making a total book value of all accounts and notes receivable of $31,049,307.54.

On January 31, 1893, the book value of the Schenectady, Lynn and Harrison plants was	$ 3,958,528.21
During the twenty fiscal years to December 31, 1912, expenditures have been made, including the cost of the Pittsfield, Erie, Fort Wayne, Sprague and National Lamp plants, aggregating	57,941,511 78
Total	$61,.900,039.99
Written off during the twenty years	37,343,929.40
Book value of above plants at December 31, 1912	$24,556,110.59

A summary of the changes in factory plants account since the last annual report is as follows:

Written off.	National Lamp Works.	Net book value Dec. 31, 1912.
$ 772,197.66	$1,993,317.51	$15,379,122.73
2,628,738.76	1,000,881.31	9,176,985.86
93,255.31		1.00
551,788.22		1.00
$4,045,979.95	$2,994,198.82	$24,556,110.59

On July 25, 1912, the board of directors authorized an issue of $60,000,000 forty year debenture bonds to be sold from time to time as required. Pursuant to this authority, there have been sold $10,000,000 of these debentures bearing interest at the rate of 5 per cent per annum.

During the year the capital stock of your company has been increased by the conversion of $510,000 of the gold debenture bonds of 1907, and also by the issue of $2500 of capital stock in exchange for $3000 of the debentures of 1892.

For the purpose of recouping the stockholders in part for dividends passed or reduced during the years 1893 to 1902, the board of directors on October 11, 1912, declared a stock dividend of 30 per cent out of surplus.

The capital stock of your company as of January 1, 1912 amounted to	$ 77,335,200.00
During the year additional stock was issued:	
In exchange for debentures of 1892	2,500.00
In exchange for debentures of 1907	510,000.00
Stock dividend	23,354,300.00
Total capital stock issued	$101,202,000.00
Reserve against $35,000 debentures of 1892, convertible at 120	29,166.67
Reserve against $211,000 debentures of 1907, convertible at par	211,000.00
Unissued and unappropriated	3,557,833.33
Total authorized capital stock	$105,000,000.00

Quarterly dividends at the rate of 8 per cent per annum have been paid during the year.

The company has no note payable, neither is there any paper outstanding bearing its endorsement.

The certificate of Messrs. Marwick, Mitchell, Peat & Company, chartered accountants, attesting the correctness of the published balance sheet and profit and loss statement accompany the report.

It is an ever increasing pleasure to testify to the ability and fidelity of the members of the administrative, engineering, manufacturing and commercial staffs, and the splendid spirit of co-operation which they have always shown in connection with the company's affairs.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1890.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Faults in Underground Cables 425
By C. A. Gaines.

Diagrams for Line Calculation 427
By H. C. Stoddard.

Telephone Statistics 428

Wooden and Metal Flumes 429
By B. A. Etcheverry.

Strike of Pacific Gas & Electric Employes 431

The Manufacture of Oil Gas—II 432
By E. C. Jones.

General Electric Co.'s Annual Report 437

Editorials 438
Recent Progress in Oil Gas Manufacture.
Partiality Toward Municipal Operation.
Location of Faults.

Personals 440

Meeting Notices 440

News of California Railroad Commission 441

Electrical Contractors 442

Trade Notes 442

Industrial 443
Improved Horn Gaps for Aluminum Lightning Arrester.
Little Damage to Submerged Motor Control Equipment.
Electric Score Board, Portland, Ore.
Cabinets Manufactured in Oregon.

New Catalogues 444

News Notes 445

Recent Progress in Oil Gas Manufacture

It is indeed one of the remarkable mile-posts in the progress of the West that L. P. Lowe, now a Western resident and enthusiast, should in Lynn, Mass., invent in 1889 the first apparatus for the manufacture of oil gas which consisted of chambers lined with refractory material, thus paving the way for the gigantic oil gas generators now so familiar in the West. This invention was, however, ahead of its era of usefulness, for in California the petroleum production of that year was but 303,220 bbls. as compared with last year's output of 87,000,000 bbls.

But the inventive genius of this son of the inventor of water gas, the late Professor Lowe, was not to go unrewarded in the annals of useful gifts to mankind, for starting in the city of Oakland in 1902 John A. Britton successfully launched an unprecedented era in oil gas manufacture. Briefly stated this process consists in heating enclosed checker brick to a high temperature—say 1800 degrees F. and then, by shutting off all outlets, heated oil is sprayed in with steam. Upon coming in contact with the highly heated brick the hydrogen and oxygen of the steam become dissociated, the former remaining in the gas as free hydrogen and the latter forming carbon monoxide with the free carbon of the oil. This product is drawn off into a receptacle and then another heating of the cooled brickwork is accomplished and so on intermittently blasting and thus generating oil gas.

E. C. Jones has, however, remarkably improved this process during the last few months at the Metropolitan plant of the Pacific Gas & Electric Company in San Francisco. The bane of the oil gas making industry has been the formation of lampblack, often as much as 30 lb. per 1000 cu. ft. of gas delivered. The lampblack, which is the carbon dissociated from the hydro-carbons of the oil, has consistently appeared until a recent discovery. It has been found that when oil fog, consisting of atomized oil and highly superheated steam, is sprayed into an atmosphere of hydrogen little, if any, of the hydro-carbons of the oil are broken down into carbon or lampblack, and hydrogen. Since it has long been known that the oxygen of steam will not unite with carbon while the carbon is combined with hydrogen in the form of hydrocarbons, it is thus seen that the hydro-carbons of the oil pass over into the gaseous state without change, while the available carbon of the oil, which is now in an incandescent state readily combines with the oxygen of the steam to form carbon monoxide. Thus, the lampblack deposit is kept at a minimum. Under the new process as low as 5 lb. per 1000 cu. ft. of gas is attained. The atmosphere of hydrogen is obtained by passing oil gas already manufactured back again through the gas generators.

Such rapid improvements in an industry scarcely a decade old are indeed a source of congratulation to the utility growth of the West.

Partiality toward Municipal Operation

The exacting of tolls and rentals for power development must ever be borne with scoffing and chafing by Western men. That those directing the issuance of permits for power development on the public domain should, on the other hand, issue free these permits to municipalities desiring to engage in power enterprises makes the problem again one of considerable discouragement to all those truly interested in seeing our Western water powers made of maximum service at the earliest date possible. The tendency of the age is unquestionably toward public ownership of utilities. Where wisely exploited and judiciously handled by enlightened, public-spirited business men such procedure may at times prove the best. Various municipalities have, however, permitted in their respective communities, millions of dollars to be invested by private enterprise, which deserves a fair and equitable treatment. So long as the people control and regulate the rates to be earned, this self-same people if engaging in competition, should in equity be restrained as far as possible to compete on the same basis as the privately owned competitor.

The new series of permits of the Department of the Interior, alluded to above, are as yet of too recent origin to bring specific citations to prove the injustice of such procedure. It is to be hoped, however, that the matter may not be of such ironclad cast that a modification is impossible.

Again, in Southern California, the citizens of Los Angeles should be equally restrained and regulated in the sales of water to neighboring communities, so far as rates are concerned in the same manner that any other utility company is handled. On the other hand, in the Hetch-Hetchy grant for San Francisco's water supply, now before congress, it would seem that the bill should be modified so that the municipality may be enabled to sell water or power in fair and open competition should the same be found profitable.

In the gigantic municipal water projects in the West, economy and efficiency require development on a large scale, often in excess of the immediate demands of the city. Public interest requires that all available water be put to beneficial use as rapidly as demand for it arises. When a city finds it thus imperative to go into the open field as a competitor, the issue should be clean and clear cut without undue partiality or favoritism being given it. It would seem, too, that at all times before entering a district or community served by existing power companies an opportunity should first be given such existing utility companies to take over the power supply or the municipality take over the existing lines at a reasonable wholesale figure in order that costly reduplication of equipment and human effort may not occur. Present distribution systems are now of such gigantic costs that the people, who must eventually pay the additional costs, would do well to heed at all times the baneful and wasteful efforts of reduplication.

And finally if there must be open, free-for-all competition by a municipality and its privately owned utility companies, it is to be hoped that all power originating on the public domain may be obtained by privately owned and competing municipally owned undertakings on the same basis of governmental tolls, if tolls there must be.

Location of Faults

The dictionary defines the word "fault" as being "a slight offense." There are many of these "slight offenses," however, that prove the pest and trial of the operating engineer's existence. In large cities where a major portion of the distribution is accomplished in underground ducts, "fault-finding" becomes an art to be ambitiously sought after far more assiduously than its usual connotation suggests to the thinking mind. The two principal faults encountered in underground distribution work are the "ground" and the "short." As is generally known cable failures are often due to an injury to the lead covering. Thus, moisture is allowed to enter the insulation and its insulating qualities are consequently reduced by permitting the current to go to the ground, producing a fault known as a "ground" or to go by a short path from conductor to conductor, which is known as a "short."

When it is remembered that only a few feet in several hundred is visible to the eye of the testing engineer, some means by which a fault may be readily located is a matter of great economic importance. Telephone cables are readily open to computation by the simple application of the well-known Wheatstone bridge. When it is remembered, however, that due to the low resistances of power cables an error of one foot in telephone work would, on the same basis of comparison, mean 150 ft. in an underground power cable of common practice, it is readily appreciated that more refined methods are necessary in computation. Especially is this true when we consider that terminal and binding resistances though infinitesimal in importance for telephone work, loom up as barriers in power fault finding, if proper means be not taken to compensate or illuminate them.

Beginning with this issue the Journal is pleased to call the attention of its readers to a series of articles which will appear from time to time by Mr. Clarence Gaines. Mr. Gaines is a technical engineer of high standing and has evolved splendid practical modification of current practices in underground cable testing in San Francisco, where he is employed as cable testing expert for one of the largest hydro-electric companies of the West. We commend his technical writings on this subject to all interested in underground cable testing.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Ed. Watkins, proprietor of the Home Electric Company, Tacoma is in the East on business.

Paul M. Lincoln, engineer for the Westinghouse Electric & Manufacturing Company, is at San Francisco.

H. A. Lardner, Pacific Coast manager for J. G. White & Company, is making a brief trip to New York City.

D. L. Huntington, president of the Washington Water Power Company of Spokane, Wash, is at San Francisco.

G. O. Muhlfeld and **Howard L. Rogers**, vice-presidents of the Stone & Webster Construction Company, are at San Francisco.

M. Ramsdell, sales manager, Puget Sound Traction, Light & Power Company, of Seattle, is taking a six-weeks vacation trip through the East.

H. H. Hornsby, manager of conduit and supply sales for the Sprague Electric Works of the General Electric Company, is at San Francisco.

B. W. Collins, superintendent of electric works for the city of Tacoma, recently made an examination of the Hebb power site on White River.

G. I. Kinney, Pacific Coast manager for the Fort Wayne Electric Works of the General Electric Company, has returned to San Francisco from Seattle.

J. M. Laughlin, general salesman for the Westinghouse Electric & Manufacturing Company, Seattle, spent a few days in the Wenatchee country recently.

M. A. Oudin manager foreign department of the General Electric Company, passed through San Francisco this week on his return to Schenectady from the Orient.

W. E. Harring, formerly with the U. S. Forestry Service, has just joined the force of the Puget Sound Traction, Light & Power Company at Seattle, as industrial agent.

A. J. Bowie, Jr., manager of the Bowie Switch Company, has returned to San Francisco from a trip over the lines of the Southern Sierras Power Company, from Riverside to Bishop.

Arthur Gunn, president of the Wenatchee Valley Gas & Electric Company, at Wenatchee, Washington, announces that the company is installing a gas plant and laying service mains.

V. H. Reineking is at Port Angeles, Washington, as resident engineer for the Olympic Power Company to make plans required for the reconstruction of this company's dam across the Elwha River.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, and **A. B. Saurman**, Pacific Coast manager for the Standard Underground Cable Company, are making a motor trip through the coast counties of central California.

E. J. Barry, electrical engineer for the St. Paul & Tacoma Lumber Company, Tacoma, is to make a series of tests on the electric logging equipment on the Potlatch Lumber Company's holdings at Elk River, Idaho. This equipment was installed by Mr. Barry.

H. V. Carter, president of the Pacific States Electric Company, and **C. C. Hillis**, manager of the Electric Appliance Company, are representing the electrical industry in the boosters excursion of the San Francisco Chamber of Commerce throughout California.

O. D. Street, at one time in charge of telephone sales for the Western Electric Company at San Francisco, and **E. W. Rockafellow**, formerly general supply sales manager for the Western Electric Company, have been appointed assistant general sales managers for the company.

H. B. Zimmerman, who has been general manager of the Grays Harbor Railway & Light Co., Aberdeen, Wash., for the past two years, has been transferred to the New York office of the Federal Light & Traction Cc. on special work. He will be succeeded by **P. A. Bertrand**, formerly of Jefferson City, Mo., who will take up his duties about June 1st.

Fifty engineering students of the Oregon Agricultural College visited Portland, Thursday, May 1st and visited various points of interest in and about Portland. The membership of the party was made up by students in the Electrical, Civil and Mechanical Departments, The party was in charge of Professors, Hildebrand, Shepard and Skelton; Messrs. Edgecomb and Rosencrantz. The city engineering department took charge of all the civil and mechanical students and took them to various points of interest in their line of work, while the electrical students visited the Bull Run power plant of the Portland Railway, Light & Power Company, both telephone exchanges and various power plants about the city.

MEETING NOTICES.

Electrical League of Southern California.

At the regular luncheon of the Electrical League of Southern California at the Angeles Hotel, on May 6th, Mr. Ira J. Francis of John A. Roebling Sons Company, gave an interesting talk on "Manufacture of Wire."

Portland Section N. E. L. A.

At the regular meeting of the Portland Section of the National Electric Light Association on May 6th, C. R. Wallis of the General Electric Company showed a series of lantern slides on the "Use of modern units in display and ornamental street lighting."

Oregon Society of Engineers.

At the regular monthly meeting of the Oregon Society of Engineers in the rooms of the Oregon Technical Club, on May 8th, Mr. Jos. N, Teal, chairman of the Oregon Conservation Commission, spoke on the subject of "Conservation." Details of the excursion to Eugene on May 17th were also announced.

Electric Development and Jovian League.

The league was favored with an address by Mr. Geo. H. Kelley, general manager of the Baker Electric Company, of Cleveland, Ohio, at this week's meeting. Mr. Kelley took as his subject "Electricity and Its Application to the Electrical Vehicle Industry," dealing with much detail and thoroughness on the efficiency of the electric truck in delivery service.

Portland Jovian Electrical League.

G. M. Barker presided at the regular lunch of the League on May 1st, H. L. Voise of the Oregon Society of Engineers giving a talk in the interest of Higher Education in Oregon. A. C. McMicken and George Sailor were appointed a committee to arrange for Jovian representation on the excursion to the University of Oregon on May 17th. Remarks were also made by T. H. Bibber, Jovian Statesman-at-large.

Seattle Jovian League.

The Pacific Telephone & Telegraph Company played the host at the luncheon of the Seattle Jovian League, May 25. Mr. Meyers, commercial manager, spoke on that phase of the company's business and touched upon the manner in which the company undertakes to handle questions so far as the public is concerned. Mr. Newell, manager of the traffic department of the company spoke of the traffic operators, how the operators are trained, how they are treated and discussed the switchboard work of the company. The U. S. Steel Products Company will handle the luncheon of the league to be given on May 9th.

Tacoma Jovian League.

The Tacoma Jovian League entertained the architects of the city on April 30 at the Olympus cafe. Music was furnished

during the lunch by the ladies' orchestra from the Princess theater. J. R. McRae, Alternate Statesman, and of the Home Electric Company, acted as toastmaster. The league has appointed a standing committee to be known as the "Architects' Information Committee," the duties of which should be to furnish the architects with data from time to time, bringing to their attention such suggestions and such information as should be helpful in improving the standard of wiring. Llewellyn Evans of the Evans Dickson Company spoke of the urgent need of more definite specifications in electrical work and stated that while many pages were given over to specifications for other portions of buildings, the electrical wiring is generally covered by a few lines, leaving many loopholes for the unscrupulous contractor to do his work in a slipshod manner and the reliable houses figuring to give a first class job were generally high. Mr. Collins of the city light department gave a very interesting talk on electrical heating and suggested that all houses and buildings be wired for same, inasmuch as the new rate to be set by the Tacoma municipal central station would be low enough to make heating and cooking by electricity a possibility. The remarks of Mr. Collins were supplemented by a talk from Mr. Turnbull of the General Electric Company, specialist on electric heating. Mr. Cheney of the Washington Surveying and Rating Bureau discussed wiring and its relation to fire hazard. He took the stand that conduit should be used to the exclusion of all other methods. Luther Twichell, a prominent architect and president of the Tacoma Architectural Society was called upon by the toastmaster to respond to the toast of how the architects of Tacoma had succeeded in organizing their trust. Mr. Twichell remarked that while they had gotten together in a social way the only trust with which he knew them to be connected was getting the grocery man to trust them for their supplies, leaving the grocery man to trust in the Lord for his pay. On behalf of the architects he stated that they would be very glad to co-operate with the electrical people and would be very much interested in the bulletins they were expected to receive from the Jovian Architectural Committee. He suggested that this information be furnished in the form of bulletins on regular sized letter paper and advised the architects to provide themselves with loose leaf binders for keeping the records. He thought the architects would greatly benefit by this information as it was quite hard for them to keep in touch with an industry that was making such rapid strides.

A. I. E. E. ANNUAL CONVENTION.

The plans for the annual convention of the institute to be held at the Hotel Otesaga, Cooperstown, New York, during the week of June 23rd, are nearly completed. Manuscripts of a large number of technical papers are now in the hands of the meetings and papers committee, to be considered for presentation at the convention. The committee has accepted the following up to date, and the balance of the papers to be presented will be announced later:

"Standardization of Method for Determining and Comparing Power Cost of Steam Plant," by H. G. Stott and W. S. Gorsuch.

"The Electric Strength of Air," by J. B. Whitehead and T. T. Fitch.

"The Positive and the Negative Corona," by W. W. Strong.

"A Theory of Rupture," by F. W. Peek, Jr.

"An Oscillograph Study of Corona," by Edward Bennett.

"Test of an Artificial Aerial Telephone Line at a Frequency of 750 Cycles Per Second," by A. E. Kennelly.

"The Behavior of Synchronous Motors During Starting," by F. D. Newbury.

"The Industrial Use of Synchronous Motors on Central Station Lines," by J. C. Parker.

"Automtaic Sub-Stations," by M. R. Summerhayes.

A symposium of short papers, including the following titles, submitted by the educational committee.

Introduction, by H. H. Norris.

"New National Association of Corporation Schools," by Wm. Henderschott.

"Legislation in Vocational Education," by W. I. Slichter.

"Results Obtained by the Pennsylvania Railroad in Their New Apprentice School," by J. P. Jackson.

"A Special Feature of Vocational Work," by A. J. Rowland.

"Vocational Training in the Far West," by Wm. Sibley.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

During the period from March 24th to April 30th, the Railroad Commission rendered decisions granting the following stock and bond applications:

Los Gatos Telephone Company to issue $15,000 of stock;

Peoples Water Company to issue $1,250,000 in promissory notes and to pledge as collateral security therefor, its general mortgage 5 per cent bonds, not to exceed $3,125,000;

Stockton Terminal & Eastern Railroad Company to issue $345,000 of bonds;

Santa Rosa and Petaluma Railway Company to issue $80,000 of bonds;

Big Four Electric Railway Company to issue $400,000 of capital stock;

Pacific Electric Company to issue $6,839,000 of bonds;

Southern Pacific Company to issue $10,120,000 of bonds;

Los Angeles Gas & Electric Company to issue $900,000 of bonds;

Clara Vista Water Company to issue $30,000 of stock and $60,000 of bonds;

Sacramento Natural Gas Company to issue $193,000 of bonds;

Terra Bella Development Company to issue $15,000 of stock;

Mt. Whitney Power & Electric Company to issue $250,000 of bonds;

The railroad commission rendered a supplemental order May 5th granting authority to the Great Western Power Co. to use the proceeds from a portion of the bonds previously authorized for extensions in the Napa district, Santa Rosa district, Oakland district, Petaluma district and the island district. The amount involved is $92,672.

The commission issued a supplemental order granting authority to the Southern Counties Gas Company to issue $8000 in bonds.

The commission has denied the application of the New Freeport Telephone & Telegraph Company for permission to raise its local rates. The company operates in a territory near Sacramento. Investigation by the commission enabled the applicant to obtain modified switching arrangements with the Pacific Telephone & Telegraph Company which will serve to increase materially its revenue. With this adjustment the increase in rates was found unnecessary.

The Pacific Telephone & Telegraph Company has filed its answer denying the charges contained in the complaint filed by the city of San Jose against telephone rates in the suburban territory.

D. C. Gillen and the Pacific Gas & Electric Company have joined in the application asking that the former be given authority to sell to the latter his electric system in the city of Colusa and vicinity for $12,000.

The commission has granted authority to the Southern Sierra Power Company to proceed with the completion of its work in San Bernardino County to such extent as may be permitted by its franchise. The company has applied for a certificate of public convenience and necessity to operate under a franchise in Kern county.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

WIRING REQUIREMENTS FOR LIGHT AND POWER.

The Portland Railway, Light & Power Company of Portland, Oregon, have issued a new set of wiring instructions to contractors, architects, owners and patrons to comply with the Public Utility Act requiring companies to file copies of their rules and regulations and also have them available for public use. The following additions and changes have been made in the instructions as published in these columns October 5-19, 1912, inclusive:

All Districts.

(A) General Wiring.

(d) In all cases where meters are to be installed in cabinets, the wiring contractor must consult the company concerning the size and location of same before making the installation.

(B) Sign Wiring.

(c) All signs wired for 110-120 volt lamps having more than 66 receptacles or requiring more than 1320 watts, must be wired for a 3-wire service with load balanced.

(d) All signs wired for 110-120 volt lamps having 66 receptacles or less, or requiring 1320 watts or less must be wired for a 2-wire service.

(f) The wiring for all series multiple signs must be arranged for connection to a 2-wire, 120 volt feeder-circuit when the number of lamps in the sign is between one hundred (100) and two hundred and sixty (260), and for connection to a 3-wire 120-240 volt feeder-circuit when the number of lamps is two hundred and sixty (260) or over.

(Signs of less than one hundred (100) lamps must not be wired on the series multiple system.)

(g) The regular multiple signs in the overhead district that are to be equipped with 12 volt Mazda sign lamps, must be supplied with and connected to a 120 volt to 12 volt transformer, when the load is 1320 watts or less, and to a 240 volt to 12 volt transformer when the load is more than 1320 watts.

(D) Lamps.

(d) Free lamp renewals are furnished in the following sizes only: 4 and 8 c.p. carbons and 50 and 80 watt gems.

Underground District.

(B) Wiring.

(e) Customers' switches must not be installed on the company's meter board, and customers' conduit should terminate at a point, so that when equipped with the proper condulet, the condulet will be at least six (6) inches from the meter casing.

Overhead District.

(B) Wiring.

(a) All service feed wires, etc. This paragraph applies to the City of Portland, St. Johns, Lents, Oregon City and Salem.

(h) The company will furnish and install the switch-box at its own expense and in all cases sufficient space must be left on the meter board for the installation of the above mentioned switch box.

The company prefers, however, that the wiring contractor furnish and install this switch box for them, providing satisfactory arrangements can be made before the installation has been started.

(i) The company will install a recording watt-hour meter upon all services, and the necessary wiring must be provided by the customer in all cases.

All meter loops of No. 8 wire or larger must be made of flexible wire. This applies to all districts.

NEWS OF THE ELECTRICAL CONTRACTORS.

The Wm. A. Mullins Electric Company, 1014 A street, Tacoma, recently secured the contract for installing a complete telephone system, fixtures and wiring—some 200 outlets complete, in the 40-room Admiralty hotel at Port Ludlow, Washington.

Davis & Hull, electrical engineers and contractors, 942 Commerce street, Tacoma, have secured the contract for motor installation in the new four-story furniture factory of F. S. Harmon & Company, for which they had previously prepared plans and specifications. The equipment throughout will be 3-phase, 220 volts, Westinghouse motors. The installation will be conduit and the most modern and up-to-date materials and methods will be used.

C. A. Young, manager Electric Construction Company, 937 Commerce street, Tacoma, reports that his company is wiring two large residences in the north end of town, also one at American Lake and another at Spanaway Lake.

Buxbaum & Cooley, electrical contractors, 68 Columbia street, Seattle, have just completed the installation of an electric light plant on the Tug Printer. They are also getting up a design for a customer in the nature of an engine room telegraph and alarm system which will indicate electrically whether or not an order given from the pilot house to the engine room has been carried out.

R. Cheadle, manager of the Union Electric Company, 93 Columbia street, Seattle, announces that the company has just completed wiring an immense sign for the Albers Brothers Milling Company on the tide flats.

TRADE NOTES.

The Puget Sound Traction, Light & Power Company, Seattle, has bought 25 single end cars; maximum traction truck, Westinghouse motors.

Kilbourne & Clark Manufacturing Company, 71 West Columbia street, Seattle, is installing a completely equipped electrical testing laboratory.

Evans-Dickson Company, consulting and contracting electrical engineers, Tacoma, have been selected by the town council of Etonville, Washington, to report on the most suitable water-power location and to prepare estimates of the cost of developing power to be used in lighting the business and residence sections, also for street lighting. The requirements will be 100 kw. The town has no provisions at present for lighting except private gasoline plants.

The Westinghouse Electric & Manufacturing Company have secured a contract from the Portland Railway, Light & Power Company for the following equipment for the Bull Run station of the company: 1-500 kw., 3-phase, 60-cycle, 6600-volt, 720 r.p.m., synchronous, self-starting motor generator set; 1-500 kw., d.c., 600-volt, flat compound wound, interpole type, railway generator; 1-250-volt direct connected exciter set. This apparatus to be used in connection with the electrification of the Mt. Hood Railway Line.

The Allis-Chalmers Company have sold the Douglas County Light & Water Company, Portland, Oregon, a single runner, vertical turbine, setting in an open flume. The complete description of the apparatus furnished is as follows: 1-560 b.h.p., 90 r.p.m., single shaft, hydraulic turbine, operating under a normal effective head of 13 ft.; 1 oil lubricating thrust bearing to carry rotating weight of turbine and generator rotor; 1 oil pressure governor; 1 alternating current revealing field generator, single bearing, vertical water wheel type.

INDUSTRIAL

IMPROVED HORN GAPS FOR ALUMINUM LIGHTNING ARRESTER.

The horn gaps for aluminum lightning arresters shown in the illustrations have been greatly improved by the addition of charging resistances. The discharge paths to the cells consist of a main gap and an auxiliary gap, with a low series resistance in parallel with the main gap.

The auxiliary gap has a smaller setting than the main gap and is fitted with a short-circuiting contact which at times of charging, bridges the auxiliary gap and charges the cells through the resistances.

In the normal operation of the arrester this arrangement of horns introduces selective paths for the discharge of lightning or other forms of potential surges. One path consists of

15,000-Volt Lightning Arrester for Three-Phase Non-Grounded Neutral Circuit.

a small auxiliary gap, a low resistance and the aluminum cells. The other path consists of only the main gap and the aluminum cells. All discharges will first spark across the auxiliary gap and pass to ground through the resistance and the cells. If, however, the quantity of discharge is too great to be dissipated through this path, the discharge automatically shunts to the main gap, where it is not impeded by the resistances. The resistance is of low value and consequently all but the heaviest discharges are taken care of by this auxiliary path.

It is well known that any arc on a high-voltage circuit, especially if it alters the electrostatic condition of the circuit, is accomplished by oscillations. An example of this is noted when an arc takes place over a line insulator or from a transmission line to an adjacent tree. The resulting oscillations may be harmless or may result in local high potentials as a result of resonance. The same phenomenon in a very mild form has been noticed at times of charging aluminum arresters.

By the addition of charging resistances and short-circuiting contacts for the horn gaps, all possibility of troubles due to the charging of arresters is greatly minimized if not entirely eliminated.

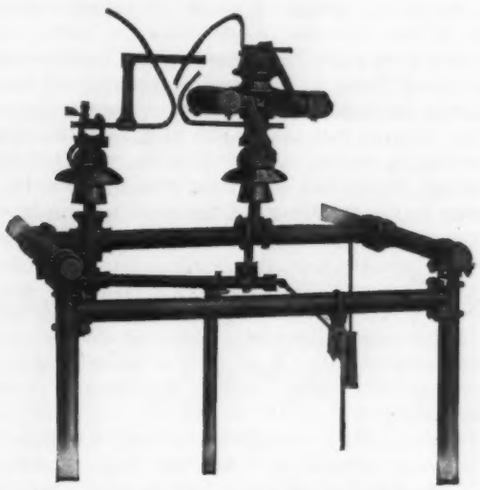
The advantage to be gained by the charging resistances and short-circuiting contacts are as follows:

1. Arresters with charging resistances have selective paths for discharges. These paths are so arranged that all but the most severe disturbances are discharged through the resistance. In case of a discharge across the main gap, the arc will be intercepted by the auxiliary horn, which is located directly above, and hence be broken through the resistance.

2. The charging is always performed through a resistance which limits the initial rush of charging current when the cells have been standing for twenty-four hours or more.

3. The short-circuiting contacts make direct contact at the auxiliary horn when charging, thereby eliminating the arcing except at the instants of making and breaking the contact.

4. The elimination of the arcing except at making and breaking contact, and the introduction of the resistance in this path modifies the current wave and actually reduces the value of the charging current.



15,000-Volt Horn Gap, showing short circuiting contact and charging resistance with auxiliary gap short circuited for charging.

5. The greater uniformity of the charging current mentioned in items 2 and 4, results in longer life to the electrolyte and cones. The charging resistances are safety devices for any poor conditions of the arrester cells.

6. The elimination of oscillations caused by the charging arcs.

7. New installations of arresters, and arresters which have remained uncharged for several days, can be put into service by charging at full potential, if they are equipped with charging resistances. Operators should, however, not rely on this additional safety device, as the most satisfactory results can be obtained only by regularly performing the charging operation.

8. The short-circuiting contacts permit the gaps to be set with the horns in the same vertical plane instead of having to offset one horn, as previously. This insures more uniform and permanent gaps, as lost motion in the mechanism has practically no effect on the gap setting.

9. Charging resistances do not sacrifice any of the valuable features of an arrester, and by their addition the arrester is made more sensitive, reliable and durable.

The horn gaps described above are manufactured by the General Electric.

PICNIC FOR GENERAL ELECTRIC CO. AND PACIFIC STATES ELECTRIC CO. EMPLOYEES.

The employes and families of the General Electric Company and Pacific States Electric Company have been invited to attend a basket picnic at Glendale Park, Niles Canyon, California, on Saturday, May 17th, as the guests of the companies. The offices, shops and store-rooms of both companies will be closed the entire day, and a special train will be engaged to take 550 or more to the grounds where every facility will be provided for a good time.

LITTLE DAMAGE TO SUBMERGED MOTOR CONTROL EQUIPMENT.

At the time of the recent disastrous flood in Ohio there were fifteen multi-voltage calendar controllers, three alternating current motor control panels, two 500 h.p. multiple switch motor starters and many miscellaneous types of Cutler-Hammer controllers in the plant of the Goodyear Tire & Rubber Company, Akron. All of this equipment was completely submerged for a considerable period. Water and mud, the latter particularly had gotten into every crevice, some of the drum controllers being found filled with mud. Upon testing the calendar panels there was apparently a considerable ground but this proved to be due to the moisture in the grid resistance insulation which was quickly dried out with blow torches and the panels ready for use as soon as the calendars were ready to be driven. The Varley coils with the exception of three which were damaged in the handling. were entirely unaffected by the long submersion in water. The cement covered resistance units also, with the exception of two broken in conveying to dry rooms, were not affected by the water. The entire equipment was put back in operation as soon as the machinery of the plant was ready and no trouble was experienced.

ELECTRIC SCORE BOARD. PORTLAND, OREGON.

One of the most unique adaptations of electricity to our every day necessity—that is at certain times of the year—is the new baseball score board of the Evening Telegram, of Portland, Oregon.

In the middle of an ordinary black metal sign structure is painted a white diagram of a baseball diamond, and every position of the players is designated by a red light. The red lights on the bases of the diagram are duplicated with white lights by which men on bases are represented.

Across the top of the structure three rows of lights are so arranged that white lights announce the innings and the score of both contending teams.

On the sides of the structure are shown the "line up" of the teams, this being painted on each day or when the "line up" is changed. The lighting of all the white lights opposite a team indicate the team is "at bat." By putting the light out opposite a name indicates that particular player is "at the bat."

If the man "at the bat" smacks a fly to center field the center field red light will light, if he catches it, another light over the painted words "Out" also is lit.

Besides indicating plays as above described, the following also can be indicated:

"Out (Stealing)," "Stolen (Base)," "Out," "Double Play," "Foul," "Safe (Error)," "Sacrifice." "Strikes," one two and three. "Balls," one, two, three and four.

On the top of the structure there is mounted a bell to announce the beginning and end of a game. All of this mechanism is operated from a table inside of the paper's office as the reports are received over the telephone and telegraph wires. This sign was constructed by the Telegram's electrician.

CABINETS MANUFACTURED IN OREGON.

The Oregon Welding & Manufacturing Company of 305 Glisair street, Portland, are manufacturing a complete line of approved iron cabinets. The boxes are made of a single sheet of metal forming the bottom and the side walls. The edges of the side walls are bolted together at the corners and the joint is welded by the oxyc-acetylene process.

The Western Electric Works of 213 Sixth street, Portland, Oregon, also mnaufacture a line of approved cabinets. In addition to cabinets they are equipped to build labeled panel-boards. The Portland Board of Education, Fourteenth and Morrison streets, build approved cabinets and tablet-boards for their own use, also the Portland Railway, Light & Power Company have made application for labels for approved cabinets—knife switches. The Portland Railway, Light & Power Company are manufacturing for their own use.

BOOK REVIEW

Bells, Indicators, Telephones, Fire and Burglar Alarms, etc. By J. B. Redfern and J. Savin. Size: 4½ x 6½ in.; 123 pages; 85 illustrations; cloth binding. Published by D. Van Nostrand Company, of New York and for sale at The Technical Book Shop, 106 Rialto Bldg., San Francisco, Cal. Price, 50c.

This is another one of the installation manuals which have been making their appearance from time to time by this publishing house. The matter set forth within its pages describes in a clear, lucid, simple manner the practical points necessary to observe in installation of all types of bells. The book is indeed useful to all having anything to do with the practical installation of such types of apparatus.

NEW CATALOGUES.

Catalogue No. 11 from the Line Material Company of South Milwaukee, Wis., describes and lists a complete stock of materials for line installations, including fixtures, brackets, posts, pins and hangers.

Conduit Catalogue No. 439, just issued by the Sprague Electric Works of the General Electric Company, is an illustrated work covering almost the entire field of conduit products in its 100 pages. This includes Greenfielduct, an attractive and complete list of boxes and covers, including new adjustable and non-adjustable gang floor boxes, Greenfield flexible steel conduit, flexible steel armored conductors, BX cable and armored cord. Considerable convenience will be found in the carefully compiled tables and information relative to the adaptability of "Fittings" to other manufacturers to Sprague boxes and covers.

The General Electric Company has issued Bulletin No. A4116 describing Isolated and Small Plant Alternating Current Switchboard Panels, both generator and feeder, for three-phase, 25 to 60-cycle circuit. The bulletin is made up principally of dimension and connection diagrams, and miscellaneous data referring to the various panels and equipments. Bulletin No. A4119 is devoted to the application of electricity to the operation of packing establishments. In the bulletin are illustrated various applications of the electric motor. No. A4084 is devoted to "Centrifugal Compressors." Bulletin No. A4113, entitled "Oil Switches for Small Capacity Industrial Application," illustrates and describes Type F, Forms P3 and P6. No. A4102, devoted to "Sewing Machine Motors for Family Size Machines," contains illustrations and descriptions of the new design of motor perfected by the company. "Cloth Pinions" is the subject of No. A4110, containing data relative to tooth dimensions and instructions for the selection of pinions. Bulletin A4061 is devoted to "Electric Arc Headlights." The foregoing suspersede previous bulletins on their respective subjects. Bulletin A4097 describes in considerable detail ventilated motors for railway service.

NEWS NOTES

INCORPORATIONS.

ANACORTES, WASH.—The Anacortes Light & Water Company, have filed articles of incorporation to engage in water, lighting and general wiring and merchandise business.

AURORA, ORE.—The Aurora Mutual Telephone Company has been organized. Geo. A. Ehlen, president; Geo. X. Goding, vice-president; Adam J. Mishler, secretary; Chas. A. Becke Jr., treasurer.

ANAHEIM, CAL.—Articles of incorporation have been filed by the La Habra Domestic Water Company, organized by residents of La Habra valley. The capital stock is $20,000. The incorporators are: W. L. York, C. J. Hinshaw, J. G. Launer, C. M. Glazier, J. C. Knight, K. G. Sargent, J. L. Morris, C. L. Brewster, C. A. Ridgway, W. H. Redfern, W. A. Davis, F. A. Hersey, La Habra Citrus Association, G. W. Beck and C. E. Sutton.

LOS ANGELES, CAL.—With paid-in capital of $1,000,000 and bond issue of another $1,000,000, the Sentinel Heights Water Company, has just been incorporated for the primary purpose of supplying big southwest section holdings of the Los Angeles Investment Company, with water, also for the purpose of supplying water to territory between western city limits of Los Angeles and Santa Monica and Venice and south as far as Inglewood. The officers of the company are: Chas. A. Elder, president; Earl B. Elder, vice-president; W. D. Deeble, Secretary, and C. L. Mowder, chief engineer and general manager.

ILLUMINATION.

MEDFORD, ORE.—W. J. Hills and Dr. E. H. French are behind plans for a gas plant here.

SAN DIEGO, CAL.—The tall electric light towers which dot San Diego will soon be removed and replaced by street arc lights.

ALBANY, ORE.—G. L. Rauch and J. D. Welch of Portland, have applied to the city council here for a franchise to install a gas plant.

VANCOUVER, B. C.—The Bowness Investment Company of Calgary, will receive tenders until 5 p. m., May 31, for power machinery and equipment.

CENTRALIA, WASH.—The county commissioners have granted a franchise to the Independent Electric Company to erect light and power lines from Winlock to Toledo.

LOS ANGELES, CAL.—The Southern California Gas Company has applied to the board of supervisors for permission to transfer the franchise of the Midway Gas Company to its own name.

EATONVILLE, WASH.—The Evans-Dickson Company, 725 Commerce street, Tacoma, has been commissioned by the town to pick a power site on Mashell River. It is planned to develop 150 horsepower.

LAS VEGAS, CAL.—A million dollars is to be invested in a power plant project destined to supply electric light and power to Las Vegas and adjoining valleys. The enterprise is backed by Ira McFarland.

LOS ANGELES, CAL.—Bids will be received up to May 19th, by the board of supervisors of Los Angeles county, for furnishing the necessary equipment for lighting with electric lights certain streets in Bairdstown lighting district.

REDLANDS, CAL.—The ornamental light system which is now being installed in the business section of the city will be enlarged. It has been decided to place lights on Fifth street, from Central avenue to Vine street, which were not included in the original contract.

DAWSON, YUKON, TERRITORY.—The power house of the Dawson Electric Light & Power Company was burned to the ground May 4th, with a loss of $200,000. Temporary electric service was established by making connections with the North Fork Hydroelectric plant.

PRINEVILLE, ORE.—The hydroelectric power plant of the Des Chutes Power Company, on Crooked River, Oregon, has been completed. The site is at a point on this stream one mile above where it empties into the Des Chutes. The one unit now ready for work has a Leffel water wheel, direct connected to generator. Transmission lines have been extended 40 miles to serve Prineville, Redmond, Culver, Madras and Metolius. L. N. Simpson, Prineville, is general manager for the company.

PORTLAND, ORE.—The Northwestern Electric company's plant on the Salmon River has been completed and by May 15th will be prepared to deliver 4000 horsepower to the Camas paper mills. For the present the company will operate only one of its two turbines. When the Portland distributing system is ready, both turbines will be used. Together they will generate about 20,000 horspower. Work on the pole line between Camas and Portland is now being rushed. It is expected that delivery in Portland will be made about September 1.

ROSEBURG, ORE.—The Douglas County Light & Water Company is building a new hydroelectric power plant on the Umpqua River at Winchester, to supplement the plant it has now in operation. The contract to furnish and install the equipment has been let to Allis-Chalmers Company, through its Portland office. The machinery is to consist of a 700 horsepower vertical, open-flume turbine, to be operated under 14 ft. head, and direct connected to a 500 k.v.a., 6600-volt, three-phase, sixty-cycle, water-wheel type, vertical alternator at ninety r.p.m.; also including all governing mechanism and exciting generator.

TRANSMISSION.

RENO, NEV.—The Elko-Lamoille Power Company, which was granted a franchise to operate in Elko county by the last legislature, has purchased the electric plant of the Elko Power & Water Company, from W. T. Smith of Elko and his associates.

PORT ANGELES, WASH.—Bids will be taken soon for the construction of the Elwha dam of the Olympic Power Company. The estimated cost is $500,000. The engineer in charge is Prof. Daniel W. Meade, professor of engineering, University of Wisconsin.

TAFT, CAL.—The San Joaquin Light & Power Company is preparing to double the capacity of the present big system at both the Midway and McKittrick substations. Two years ago in July the company started operations in the Midway field with one 150 h.p. generator and a gas engine. The small generator was soon thrown out and the substations installed. In the Midway and McKittrick fields at the present time there are in the neighborhood of 325 motors drawing power from the substation.

TRANSPORTATION.

SALEM, ORE.—The State Railroad Commission has ordered the Corvallis & Eastern to rebuild practically its entire railroad of 140 miles.

ABERDEEN, WASH.—The Grays Harbor Railway & Light Company will spend from $15,000 to $20,000 in changing of trackage and other improvements.

PORTLAND, ORE.—The Oregon Electric, Joseph H. Young, president, is considering tunneling of the hills west of the Willamette River. The project would cost $500,000.

SAN JOSE, CAL.—Franchises for portions of the electric railroads in this city formerly operated under county franchises have been granted the San Jose Railroads by the city.

SEATTLE, WASH.—The council has granted a franchise to the Seattle & Montana Railway to lay tracks and operate the same along and across certain streets and avenues in this city.

LEWISTON, IDAHO.—Lewiston-Clarkston Valley Railway Company, F. L. Sturm, president, have awarded a contract to the General Electric Company, through W. C. Campbell, Portland, for electrical appliances.

GLENDALE, CAL.—Application has been made to the city council by Pacific Electric Railway Company for a franchise for 50 years, from Everett to Glendale avenue on Broadway, and right to cross Fifth, Sixth and Ninth streets. This is the initial steps on the part of the company toward extending the line through the eastern section of the city.

ANAHEIM, CAL.—The supervisors have a request from the Pacific Electric Company for permission to make fills at a number of street crossings between Santa Ana and Stanton. The communication states that the company is anxious to complete double-tracking between these points, and asks that the resolution be passed as soon as possible, in order to take the matter up with the railroad commission and begin work.

LOS ANGELES, CAL.—With the Pacific Electric application to the city council for a 40-year franchise for a four-track elevated railroad from the present Main street terminal east to San Pedro street, at an estimated cost of $600,000, the first step was taken in a plan which contemplates the entire elimination of grade crossings within a good part of the city. The elevated way will commence at San Pedro street, two tracks wide, and extend to an overhead crossing at San Julian street, where the two tracks will be increased to four, extending thence to the main station, crossing Wall street, Maple avenue and Los Angeles street. The present elevated structure over Los Angeles street will be incorporated in the new elevated but the deck will be widened to accommodate four tracks while the passage entrance into the station will be correspondingly enlarged.

SAN FRANCISCO, CAL.—The supervisors have passed to print a declaratory ordinance announcing its purpose to provide for such extensions of the existing municipal railway system as shall give lines to the exposition grounds, the Presidio and intervening points from the waterfront and from Market street via the present Union street line, Stockton street, Van Ness avenue and connections; also a road to and upon Potrero avenue to Twenty-fifth street; another out Market street to Church street and along the latter to a terminus at Thirtieth, and still another on California street from First avenue to Thirty-third. The estimated cost of the proposed acquisition of the railway lines in question is $3,500,000, which is to be provided by a bond issue. The board also adopted a resolution formally soliciting offers for the sale to the city of lines such as those desired to be acquired, the charter providing that before public utilities may be created by the city by original construction proposals for the sale of such as may be already in existence under private ownership shall be invited. A proposition may be received from the Presidio & Ferries Railway Company, whose franchise lapses next December, to turn over its equipment and other property for the city's use, since the so-called Union street line, extending from the ferries via Washington and Jackson streets, to Montgomery, and thence along Columbus avenue and Union and other streets to the Presidio, has been counted in as an integral and important part. The addition of the line on California street from First avenue westward is made possible by the fact that the United Railroads' franchise over almost this entire stretch of street has lapsed, though the cars are still running by informal agreement on the part of the city.

TELEPHONE AND TELEGRAPH.

CARSON CITY, NEV.—The local telephone company is making a number of changes in its lines in this city. The number of phones on party lines will be reduced.

SUSANVILLE, CAL.—A merger has been completed of the California Northern Telephone & Telegraph Company and the California & Oregon Telephone Company. This includes the acquirement by lease of the lines of the Nevada-California-Oregon Telephone Company, which operates between Reno and Lakeview, Ore. The deal was engineered by Hills, Hendricks and Mathews of the California Northern Telephone & Telegraph Company, and has been pending for some time. The California & Oregon Telephone Company will now branch out and construct standard telephone toll lines and exchanges, as well as operate the telegraph business in the northern country. The toll lines and exchanges will be operated in connection with the leased line of the Nevada-California-Oregon Company, known as the Dunaway line, which has heretofore been controlled by the Wingfield interests. The largest exchange will immediately be built at Alturas. Under the rearrangement of wires contemplated the California & Oregon Telephone Company will operate all telephone and telegraph business north of Doyle, with a telegraph and telephone outlet to Reno, and the California Northern Telephone & Telegraph Company will operate all the telephone business in this locality, as heretofore. A direct circuit will be provided between Susanville and Reno. The California Northern Company will also operate the Susanville office of the W. U. Telegraph Company as soon as that corporation builds its line into Susanville along the line of the Fernley-Lassen branch of the Southern Pacific road. The head offices of both companies will be in Susanville, and W. E. Hills, vice-president and general manager of the California Northern Telephone & Telegraph Company will be in charge.

WATERWORKS.

LACONNER, WASH.—The city council has determined to buy the waterworks system of J. O. Festerf if the price is made satisfactory. The price originally asked was $9500.

LIVINGSTON, MONT.—The election on the issuing of bonds in the sum of $225,000 for a waterworks system, carried by a large majority. The money will be used either to purchase the present plant or to build a new one.

LODGE, MONT.—The election to bond the city in an additional sum of $30,000 for the purpose of laying larger water mains (12 inch) from the head gate of the present system to increase the city supply, carried by a vote of 121 to 19. The date for the sale of the bonds has been fixed for May 29.

RIVERSIDE, CAL.—In order that no possible technical objections may stand in the way of the sale of proposed issue of $1,160,000 water works bonds, the city council has authorized Mayor Peters to engage the firm of Dillon, Thompson & Clay, attorneys of New York, for an opinion on the validity of the proceedings.

LOS ANGELES, CAL.—A private water system near Colton has been purchased by the Clara Vista Water Company, and it is understood that the new owners will make improvements and extensions. To carry out the plans the Clara Vista Company will issue bonds in the sum of $60,000 and $30,000 in stock.

SANTA MONICA, CAL.—Many test holes are being sunk by Messrs. Quinton and Code, hydraulic engineers, of Los Angeles, in making examination of the distributing systems of the four water companies supplying consumers here. The purpose is to furnish an estimate of the value of local plants as a basis for calculation of the cost of the municipal water plant, including the cost of taking over such of the local plants as may prove serviceable.